

# 2021 IECC® Transition from the 2015 IECC®

*Based on the 2021 International Energy Conservation Code® (IECC®)*

## Description

- This seminar will assist participants in implementing the transition from the 2015 *International Energy Conservation Code® (IECC®)* to the 2021 edition



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## Prerequisite information



It is expected that seminar participants are already familiar with the 2015 IECC and its application.

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## Objectives

- Upon completion, participants will be better able to:
  - Identify the most significant differences between the 2015 IECC, 2018 IECC and 2021 IECC
  - Explain the differences between the current and previous editions
  - Identify changes in organization and code requirements
  - Identify the applicability of design, plan review and inspection requirements

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## Course Overview



- Introductions
- Overview of the IECC
- Selection of Course Content
- Administrative and General Significant Changes
- Commercial Significant Changes
- Residential Significant Changes
- Additional Resources

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## Jerica Stacey



Energy Code Specialist  
Product Development  
International Code Council  
Ammon, Idaho  
Tel: 888-422-7233 x7757  
Email: [jstacey@iccsafe.org](mailto:jstacey@iccsafe.org)

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## About You



Plans  
examiners



Inspectors



Building  
officials



Builders



Designers



Engineers or  
Architects

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## Overview of the IECC

### Building Codes

- Codes are minimum requirements to safeguard health, safety and welfare of the public and occupants or users of spaces or buildings
- Adopted by governmental agencies to ensure that buildings are built in a safe manner



- People expect when entering a building to be safe from inherent dangers caused by natural or man-made disasters

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# Family of I-Codes

- International Private Sewage Disposal Code
- International Property Maintenance Code
- International Zoning Code
- International Performance Code
- International Swimming Pool & Spa Code
- International Wildlife-Urban Interface Code
- International Fuel Gas Code
- International Mechanical Code
- International Green Construction Code
- International Existing Building Code
- **International Energy Conservation Code**
- International Plumbing Code
- International Fire Code
- International Building Code
- International Residential Code



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# Coordination of Energy and the Other I-Codes

Example: I-Codes referenced in Residential provisions

IEBC—21	International Existing Building Code® R501.4
IECC—06	2006 International Energy Conservation Code® R202
IECC—09	2009 International Energy Conservation Code® R406.2
IECC—15	2015 International Energy Conservation Code® Table R406.5
IFC—21	International Fire Code® R201.3, R501.4
IFGC—21	International Fuel Gas Code® R201.3, R501.4
IMC—21	International Mechanical Code® R201.3, R403.3.3, R403.3.4, R403.6, R501.4
IPC—21	International Plumbing Code® R201.3, R501.4
IPMC—21	International Property Maintenance Code® R501.4
IPSDC—21	International Private Sewage Disposal Code® R501.4
IRC—21	International Residential Code® R201.3, R303.1.1, R303.2, R402.1.1, R402.2.10.1, R403.3.3, R403.3.4, R403.6, R501.4



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# About the IECC

- The IECC regulates the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.
- This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective.
- This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.



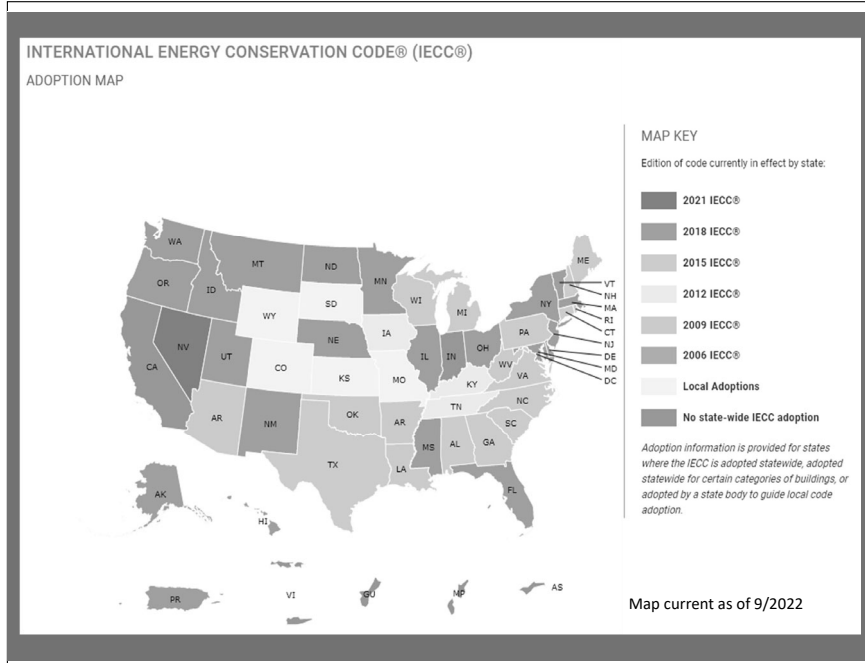
C/R101.3

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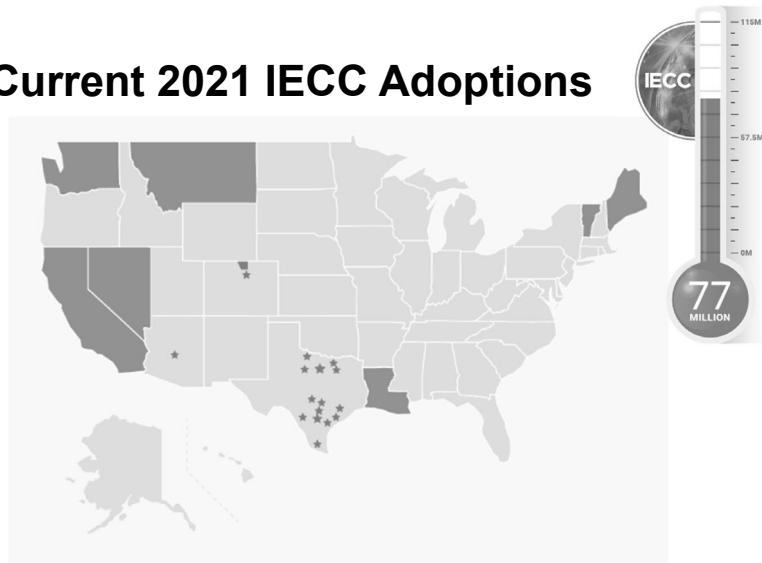
# Code Adoption

**C101.1 Title.** This code shall be known as the *Energy Conservation Code* of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as "this code."

- IECC is a "model" code
  - When adopted by governmental agency, becomes law
  - Adopted by federal, state and local government agencies
  - Adopted through legislation or delegate to a board or state agency
  - Adopting legislation or ordinance is required to go through a public hearing process
  - Many jurisdictions develop amendments to model codes
- Sample adoption ordinance included in all I-codes
- Jurisdiction must adopt a specific code edition
- Any appendix must specifically be adopted
- Code official is responsible for assuring substantial compliance with the adopted code and any state laws dealing with construction issues



## Current 2021 IECC Adoptions

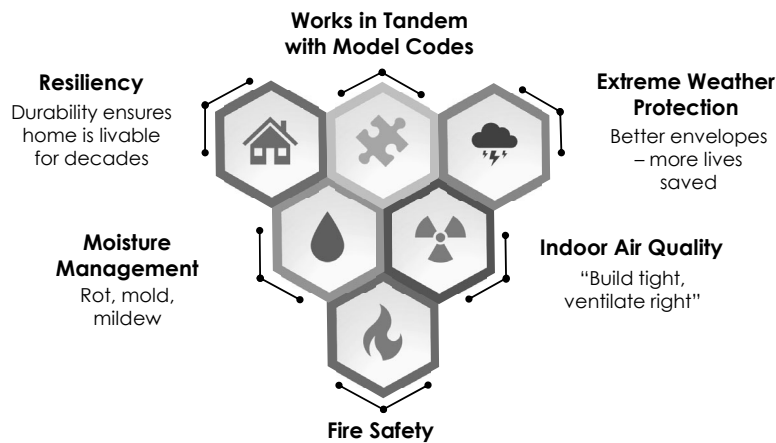


# The Case for Building Energy Codes

- Energy savings
- Emissions reductions
- Cost savings
- Enhanced occupant comfort
- Improved grid reliability
- Synchronicity with Suite of I-Codes



# Energy as a Life Safety Code



ENERGY-EFFICIENT CODES COALITION

INSTITUTE FOR MARKET TRANSFORMATION

## How Energy Codes Affect You

Energy codes govern the efficiency of the lighting, walls, and systems that surround where you live and work. A space built to a more efficient energy code increases comfort and results in lower energy bills for your home and business.

**Dimmers, daylight, and occupancy controls** help to provide lights when you need them, and to save energy when you don't.

**Increased insulation and tighter construction** reduce energy needs and help you stay warm or cool in the event of a power outage.

**High efficacy lights** like LEDs use less energy and last years longer than incandescents, with LEDs lasting 25-30,000 hours compared to 1,000 for an incandescent.

**Energy-efficient windows** let daylight and views in while minimizing heat gain from the sun.

**Properly-sized mechanical equipment** reduces first costs and runs more efficiently, maintaining comfortable temperatures and humidity levels in the space.

**Proper sealing** around the windows and doors reduces drafts and makes rooms more comfortable.

**Programmable thermostats** and other control systems can help automatically lower costs when the space is empty.

**Well-insulated hot water piping** reduces heat loss and helps you get hot water faster.

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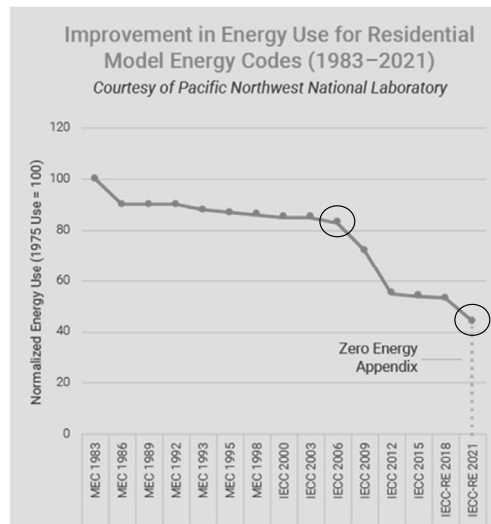
# Residential Energy Efficiency Improvements

- Increased Efficiency
  - Roughly a 10% increase in energy savings over the 2018 IECC [RE] based on the final DOE determination

RESIDENTIAL: 2021 INTERNATIONAL ENERGY CONSERVATION CODE

On July 28, 2021, DOE issued a determination <sup>25</sup> that the 2021 International Energy Conservation Code (IECC) will improve energy efficiency in residential buildings. In support of this determination, DOE conducted a technical analysis evaluating the impacts of the updated code (relative to the 2018 IECC edition). DOE estimates national savings of approximately:

- 9.38 percent site energy savings
- 8.79 percent source energy savings
- 8.66 percent energy cost savings
- 8.66 percent carbon emissions



**Roughly a 40% increase in efficiency from the 2006 IECC**

## 2021 Residential Changes Analyzed

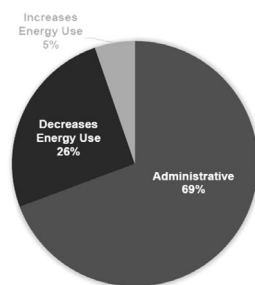


Figure 2. Categorization of Approved Code Changes

According to DOE Determination:

A total of 114 approved code change proposals were identified and analyzed for the 2021 IECC. Analyses of those changes indicate the following:

- 35 changes with a direct impact on energy use in residential buildings—29 of these are expected to reduce energy use while 6 are expected to increase energy use
- 79 additional changes—changes in this category are administrative, impact non-energy portions of the code, or are otherwise not expected to have a direct impact on energy savings under the applied methodology

# Commercial Energy Efficiency Improvements – ASHRAE 90.1

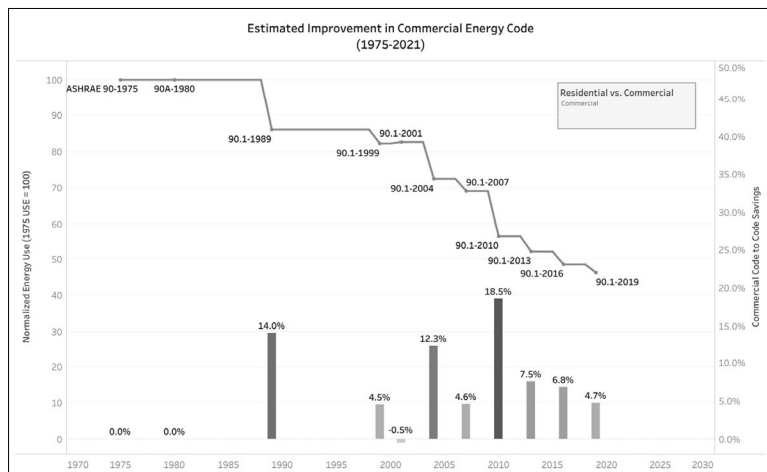
- Increased Efficiency – Commercial
  - ASHRAE 90.1 – 2019 ~ 5% greater energy efficiency

## COMMERCIAL: ANSI/ASHRAE/IES STANDARD 90.1-2019

On July 28, 2021, DOE issued a determination <sup>23</sup> that Standard 90.1-2019 will achieve greater energy efficiency in buildings subject to the code. DOE estimates national savings in commercial buildings of approximately:

- 4.7 percent site energy
- 4.3 percent source energy
- 4.3 percent energy cost
- 4.2 percent carbon emissions

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Source: Building Energy Codes Program, [energycodes.gov](http://energycodes.gov)

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# Commercial Energy Efficiency Improvements – IECC

- September 2022 DOE analysis of commercial provisions of the 2021 IECC
- Site energy savings of 12.1% at the aggregate national level compared to the 2018 IECC edition
- On a national weighted average basis, the 2021 IECC is 6.5% more efficient for site energy use than ASHRAE 90.1-2019
- Full report available at [energycodes.gov](http://energycodes.gov)

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# How the Code is Organized

- There are two separate sets of provisions
  - **Commercial** and **residential** energy efficiency requirements that apply to the building thermal envelope, mechanical and service water heating systems, and lighting and electrical systems
  - Administrative provisions and definitions specific to each commercial and residential set of regulations are also included



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CHAPTER 2 DEFINITIONS . . . . . C2-1	CHAPTER 2 DEFINITIONS . . . . . R2-1
CHAPTER 3 GENERAL REQUIREMENTS . . . . . C3-1	CHAPTER 3 GENERAL REQUIREMENTS . . . . . R3-1
CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY . . . . . C4-1	CHAPTER 4 RESIDENTIAL ENERGY EFFICIENCY . . . . . R4-1
CHAPTER 5 EXISTING BUILDINGS . . . . . C5-1	CHAPTER 5 EXISTING BUILDINGS . . . . . R5-1
CHAPTER 6 REFERENCED STANDARDS . . . . . C6-1	CHAPTER 6 REFERENCED STANDARDS . . . . . R6-1
APPENDIX CA BOARD OF APPEALS—COMMERCIAL . . . . . APPENDIX CA-1	APPENDIX RA BOARD OF APPEALS—RESIDENTIAL . . . . . APPENDIX RA-1
APPENDIX CB SOLAR-READY ZONE—COMMERCIAL . . . . . APPENDIX CB-1	APPENDIX RB SOLAR-READY PROVISIONS—DETACHED ONE- AND TWO-FAMILY DWELLINGS AND TOWNHOUSES . . . . . APPENDIX RB-1
APPENDIX CC ZERO ENERGY COMMERCIAL BUILDING PROVISIONS . . . . . APPENDIX CC-1	APPENDIX RC ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS . . . . . APPENDIX RC-1
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## Applicable Projects

- IECC provisions apply to several different project types
  - New construction
  - Newly conditioned space
  - Additions, alterations and repairs to existing buildings
  - Mixed-use buildings
  - Change in occupancy



C/R101.2

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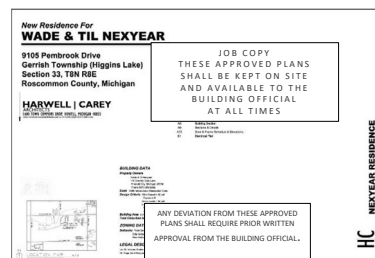
## Compliance Process

1. Determine if the project must comply with the IECC
2. Determine if the project is residential or commercial
3. Submit compliance documentation
4. Plan reviewer ensures the documentation is clearly identified and code compliant
5. Code official confirms that energy-using features of the building's are installed per the approved plans and documentation

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## Examination of Documents (Plan Review)

- Plan reviewer's responsibility to verify that the energy code compliance documentation submitted with the plans is completed correctly and that the efficiency levels called out on the plans meet or exceed those provided by the code
- Field inspectors will use the approved plans and specifications as a reference for inspection



C/R103.3 – 103.5

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# Inspections

- All permitted construction is subject to inspection
- Construction may not be concealed without inspection approval
- A final inspection is required before occupancy
- A building may be reinspected when determined necessary by the code official
- Every jurisdiction that adopts building codes establishes a fee schedule



C/R105

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# Inspections Continued

## Required Commercial Inspections

- Footing and foundation insulation
- Thermal envelope
- Plumbing system
- Mechanical system
- Electrical system
- Final inspection

## Required Residential Inspections

- Footing and foundation inspection
- Framing and rough-in inspection
- Plumbing rough-in inspection
- Mechanical rough-in inspection
- Final Inspection

C/R105.2

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# Additional Compliance Information



- The code official approves the use of specific computer software, worksheets, compliance manuals and other similar materials
- Alternate materials, design and methods of construction and equipment are permitted
  - Owner or owner's authorized agent submits
  - Code official reviews and approves or denies, provides a written statement
- Above code programs may be deemed compliant
  - Must comply with several IECC requirements
    - Total Building Performance requirements, res and com
    - 2009 IECC backstop for residential

C/R101 and 102

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## Useful Publications

Available on [shop.iccsafe.org](http://shop.iccsafe.org)

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### C403.4.2.3 Automatic Start and Stop

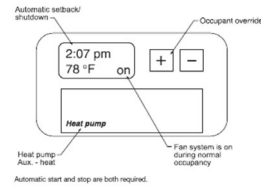
CHANGE TYPE: Modification

CHANGE SUMMARY: In addition to automatic start controls, HVAC systems with direct digital controls serving individual zones must have automatic stop controls.

2021 CODE: **C403.4.2.3 Automatic start and stop (Mandatory).** Automatic start and stop controls shall be provided for each HVAC system. The automatic start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. Automatic stop controls shall be provided for each HVAC system with direct digital control of individual zones. The automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2°F (1.1°C) before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits.

CHANGE SIGNIFICANCE: The 2018 IECC established requirements for automatic start controls. These controls automatically adjust the start time for warm up or cool down of the zone prior to occupancy so that the zone is at the appropriate temperature when it is scheduled to be occupied. Automatic stop controls, sometimes referred to as an optimum stop, are now required for HVAC systems with direct digital controls serving individual zones. The controls must be capable of decreasing the heating temperature setpoint by 2°F and increasing the cooling setpoint by 2°F for some time period before the scheduled unoccupied period where the temperature can drift within the comfort range using the adjusted setpoints. Typically this results in little heating or cooling for 30 to 60 minutes at the end of the occupied period.

This new provision is applicable to both IECC compliance paths.



## Selection of Topics

Provisions addressed based primarily on:

- Frequency of application
- Special significance
- Change in application

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# Margin Markings within the 2018 I-Codes



**Solid vertical lines** indicate a technical change from the requirements of the 2018 edition.



**Arrows** indicate where a section, paragraph, item in a list, exception or table has been deleted.



**A single asterisk [\*]** indicates that text or a table has been relocated elsewhere in the code.



**A double asterisk [\*\*]** indicates that the section or table immediately following has been relocated here from a different section.

## Relocations

IECC COMMERCIAL RELOCATIONS

2021 LOCATION	2018 LOCATION
C402.2.1.5	C402.2.1.1
C404.6.1.1	C404.7
C405.2.3.1	C405.2.2.2
C405.2.4	C405.2.3
C501.2	C501.4
C503.2.2.1	C401.2.1

IECC RESIDENTIAL RELOCATIONS

2021 LOCATION	2018 LOCATION
Table R402.1.2	Table R402.1.4
Table R402.1.3	Table R402.1.2
R403.3.2	R403.3.7
R403.3.3	R403.3.6
R403.3.3.1	R403.3.6.1
R403.3.4	R403.3.2
R403.3.4.1	R403.3.2.1
R403.3.5	R403.3.3
R403.3.6	R403.3.4
R403.3.7	R403.3.5

## Course Icons



**Addition**



**Deletion**



**Modification**



**Clarification**

# Administrative and General Changes

Commercial and Residential Chapters 1 through 3

## Chapter 1: Scope and Administration

- Chapter 1 is in two parts
- Establishes the limits of applicability of the code and describes how the code is to be applied and enforced
- Establishes authority and duties of the code official appointed by the authority having jurisdiction
- Establishes the rights and privileges of the design professional, contractor and property owner

CHAPTER 1 SCOPE AND ADMINISTRATION .....	C1-1
PART 1—SCOPE AND APPLICATION .....	C1-1
Section	
C101 Scope and General Requirements .....	C1-1
C102 Alternative Materials, Design and Methods of Construction and Equipment .....	C1-1
PART 2—ADMINISTRATION AND ENFORCEMENT .....	C1-1
Section	
C103 Construction Documents .....	C1-1
C104 Fees .....	C1-3
C105 Inspections .....	C1-3
C106 Notice of Approval .....	C1-4
C107 Validity .....	C1-4
C108 Referenced Standards .....	C1-4
C109 Stop Work Order .....	C1-4
C110 Board of Appeals .....	C1-4

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**2021** 

## Alignment with Other I-Codes

- Proposals by BCAC were introduced to better align Chapter 1 with the other I-Codes

### Commercial

- Within C102 Alternative Materials, C106 Notice of Approval, C109 Stop Work Order

### Residential

- Within R102 Alternative Materials, R106 Notice of Approval, R109 Stop Work Order, and R110 Means of Appeals

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# C101.4.1 Mixed residential and commercial buildings

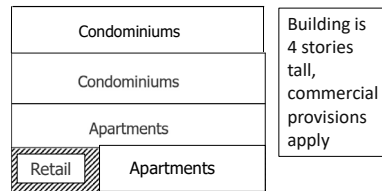
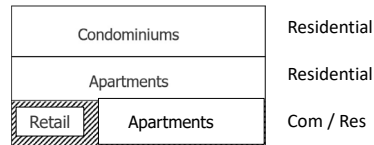
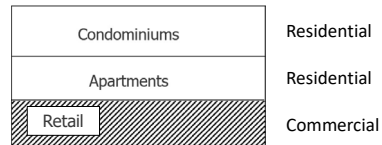
- The phrase “mixed occupancy” was replaced with “mixed residential and commercial buildings”
- Provides clarification but no change in application

## Mixed Residential and Commercial Buildings

- In buildings with both residential building and commercial building portions, each portion must be separately considered and meet the applicable provisions of the IECC

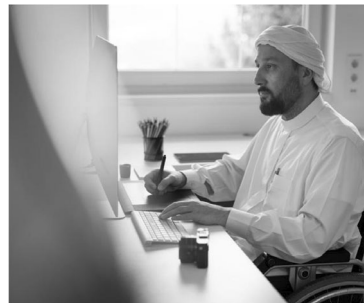


C/R101.4.1



## C/R103.1 Digital Construction Documents

- Construction documents may be submitted in a digital format



## C/R103.2 Information on Construction Documents

- Information required on the construction documents has been expanded to include an indication of the energy compliance path used
- Clarifies requirements for air barrier and air sealing details and locations



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## C103.2 Information on Construction Documents Continued

1. Energy compliance path.
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of daylight zones on floor plans.
13. Air sealing details, barrier and air sealing details, including the location of the air barrier.

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## Chapter 2: Definitions

- IECC includes definitions for specific terms
- Most defined terms are *italicized* in code text
  - When definition is key to understanding a particular code provision
- Undefined terms
  - Other I-Code definitions apply
  - Common-use definitions apply

### SECTION R202 GENERAL DEFINITIONS

**ABOVE-GRADE WALL.** A wall more than 50 percent above grade and enclosing *conditioned space*. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and *skylight* shafts.

**ACCESS (TO).** That which enables a device, appliance or equipment to be reached by *ready access* or by a means that first requires the removal or movement of a panel or similar obstruction.

**ADDITION.** An extension or increase in the *conditioned space* floor area, number of stories or height of a building or structure.

**AIR BARRIER.** One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the *building thermal envelope* and its assemblies.

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## On-site Renewable Energy and Renewable Energy Resources

- **ON-SITE RENEWABLE ENERGY.** Energy derived from renewable energy resources harvested at the building project site. solar radiation, wind, waves, tides, landfill gas, biogas, biomass or the internal heat of the earth. The energy system providing onsite renewable energy shall be located on the project site.
- **RENEWABLE ENERGY RESOURCES.** Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.



C202

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## Biogas and Biomass

- **BIOGAS.** A mixture of hydrocarbons that is a gas at 60°F (15.5°C) and 1 atmosphere of pressure that is produced through the anaerobic digestion of organic matter.
- **BIOMASS.** Nonfossilized and biodegradable organic material originating from plants, animals and/or micro-organisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the nonfossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of nonfossilized and biodegradable organic material.



C202

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## Fan Efficiencies

New definitions related to fans introduce and support the Fan Energy Index



- **FAN ENERGY INDEX (FEI).** The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated in accordance with AMCA 208.
- **FAN, EMBEDDED.** A fan that is part of a manufactured assembly where the assembly includes functions other than air movement.
- **FAN ARRAY.** Multiple fans in parallel between two plenum sections in an air distribution system.
- **FAN NAMEPLATE ELECTRICAL INPUT POWER.** The nominal electrical input power rating stamped on a fan assembly nameplate.
- **FAN SYSTEM ELECTRICAL INPUT POWER.** The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors.

C202

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## High-Efficacy Light Sources



**HIGH-EFFICACY LIGHT SOURCES.** Any lamp with an efficacy of not less than 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

R202

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## Renewable Energy Certificate

- **RENEWABLE ENERGY CERTIFICATE (REC).** An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).



R202

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## Other New or Revised Definitions

### New

- Access (to)
- Change of Occupancy
- Luminaire Level Lighting Control
- Networked Guest Room Control System
- Ready access (to)

### Revised

- Addition
- Air Barrier
- Demand Recirculation Water System
- Entrance Door
- Fenestration
- Skylight

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## Other New or Revised Definitions

- Commercial New
  - Data center, Data center systems
  - Direct Digital Control (DDC)
  - Enthalpy recovery ratio
  - Fault detection and diagnostics (FDD) system
  - Information technology equipment
  - Internal curtain system
  - Large diameter ceiling fan
  - Testing unit enclosure area
  - Thermal distribution efficiency (TDE)
  - Vegetative roofs
  - Visible transmittable, annual
- Commercial Revised
  - General lighting
  - Green houses
  - On-site renewable energy
  - Skylights
  - Wall, above-grade
- Residential New
  - Access (to)
  - Cavity insulation
  - Dimmer
  - Dwelling unit enclosure area
  - Occupant sensor control
  - On-site renewable energy
  - Ready access (to)
  - Renewable energy certificate (REC)
  - Renewable energy sources
  - Thermal distribution efficiency (TDE)
- Residential Revised
  - Demand Recirculation Water System
  - Skylights
  - High-efficacy light sources
  - Roof recover

C/R202

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## Chapter 3: General Requirements

- Includes broadly applicable requirements not at home in other chapters having more specific coverage of subject matter
- Establishes climate zone by US counties and territories and includes methodology for determining climate zones elsewhere
- Contains product rating, marking and installation requirements for materials such as insulation, windows, doors and siding

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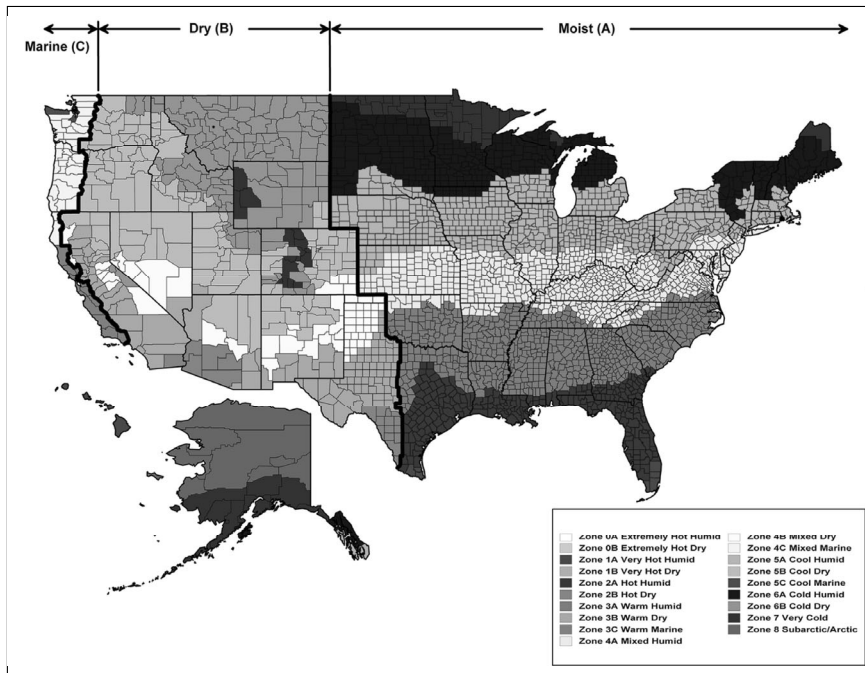
## C/R301.3 Climate Zone Definitions



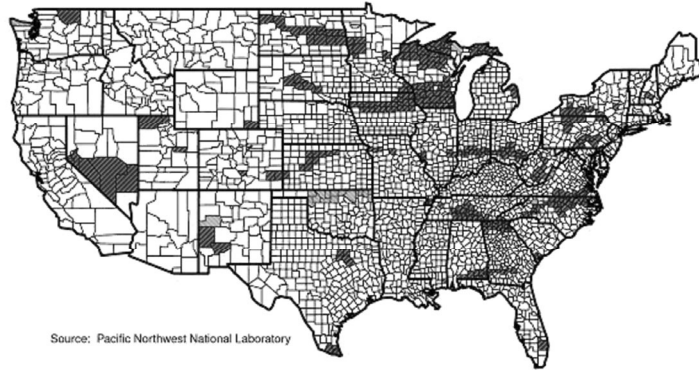
### Climate zones updated

- New Climate Zone 0
- Align with ASHRAE 169, ASHRAE 90.1, 2018 IgCC
- 10% of US counties assigned new CZ

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## County-Level Climate Zone Changes



C/R301.3

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## C/R301.3 Climate Zone Definitions Continued 2021

TABLE R301.3(2) R301.3 Thermal Climate Zone Definitions

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
0	10,800 < CDD50°F	6000 < CDD10°C
1	9,000 < CDD50°F < 10,800	5000 < CDD10°C < 6000
2	6,300 < CDD50°F ≤ 9,000	3500 < CDD10°C ≤ 5000
3	4,500 < CDD50°F ≤ 6,300 AND HDD65°F ≤ 5,400	CDD10°C < 3500 AND HDD18°C ≤ 3000
4	3,600 < CDD50°F ≤ 4,500 AND HDD65°F ≤ 5,400	CDD10°C < 2500 AND HDD18°C ≤ 3000
5	HDD65°F ≤ 3,600	HDD18°C ≤ 2000
6	3,600 < HDD65°F ≤ 5,400	2000 < HDD18°C ≤ 3000
7	CDD50°F < 6,300 AND 5,400 < HDD65°F ≤ 7,200	CDD10°C < 3500 AND 3000 < HDD18°C ≤ 4000
8	7,200 < HDD65°F ≤ 9,000	4000 < HDD18°C ≤ 5000
9	9,000 < HDD65°F ≤ 12,600	5000 < HDD18°C ≤ 7000
10	12,600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F) - 32]/1.8.

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# Improved Useability

Mandatory and Prescriptive labels removed in favor of mandatory tables

- Total Building Performance
- Energy Rating Index

## 2018 IECC

**C402.5 Air leakage—thermal envelope (Mandatory).** The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft<sup>2</sup> (2.0 L/s • m<sup>2</sup>). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

## 2021 IECC

**C402.5 Air leakage—thermal envelope.** The building thermal envelope shall comply with Sections C402.5.1 through Section C402.5.11.1, or the building thermal envelope shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.

# Improved Useability

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE		TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE	
SECTION*	TITLE	SECTION*	TITLE
<i>Envelope</i>			
C402.5	Air leakage—thermal envelope	R401.2.5	Additional energy efficiency
<i>Envelope</i>			
C403.1.1	Calculation of heating and cooling loads	R401.3	Certificate
C403.1.2	Data centers	<i>Building Thermal Envelope</i>	
C403.2	System design	R402.1.1	Vapor retarder
C403.3	Heating and cooling equipment efficiencies	R402.2.3	Eave baffle
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls	R402.2.4.1	Access hatches and doors
C403.5.5	Economizer fault detection and diagnostics	R402.2.10.1	Control space wall insulation installation
C403.7, except C403.7.4.1	Ventilation and exhaust systems	R402.4.1.1	Insulation
C403.8, except C403.8.6	Fan and fin controls	R402.4.1.2	Testing
C403.9	Large-diameter ceiling fans	R402.5	Minimum fenestration U-factor and SHGC
C403.11, except C403.11.3	Refrigeration equipment performance	<i>Mechanical</i>	
C403.12	Construction of HVAC system elements	R403.1	Controls
C403.13	Mechanical systems located outside of the building thermal envelope	R403.3, including R403.3.1, except Section R403.3.2, R403.3.3 and R403.3.6	Ducts
C404	Service water heating	R403.4	Mechanical system piping insulation
C405, except C405.3	Electrical power and lighting systems	R403.5.1	Heated water circulation and temperature maintenance systems
C408	Maintenance information and system commissioning	R403.5.3	Drain water heat recovery units
		R403.6	Mechanical ventilation
		R403.7	Equipment sizing and efficiency rating
		R403.8	Systems serving multiple dwelling units
		R403.9	Snow melt and ice systems
		R403.10	Energy consumption of pools and spas
		R403.11	Portable spas
		R403.12	Residential pools and permanent residential spas
		<i>Electrical Power and Lighting Systems</i>	
		R404.1	Lighting equipment
		R404.2	Interior lighting controls

\* Reference to a code section includes all the relative subsections except as indicated in the table.

# Commercial Significant Changes

Chapter 4, Chapter 5, Appendices

## Commercial Provisions

- Pertain to buildings not covered by the Residential Provisions of the IECC
- New and existing buildings
- Apply to the buildings' sites and associated systems and equipment



C101.2



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## Commercial Energy Efficiency, Chapter 4

- C401 General
- C402 Building Envelope Requirements
- C403 Building Mechanical Systems
- C404 Service Water Heating
- C405 Electrical Power and Lighting Systems
- C406 Additional Efficiency Requirements
- C407 Total Building Performance
- C408 Maintenance Information and System Commissioning

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**2021** 

## C401.2 Compliance Path Options

- Compliance path options for the commercial provisions of the IECC are named and the sections required for each option are outlined
  - Prescriptive Compliance
  - Total Building Performance
  - ASHRAE 90.1

**C401.2 Application.** Commercial buildings shall comply with Section C401.2.1 or C401.2.2.

**C401.2.1 International Energy Conservation Code.** Commercial buildings shall comply with one of the following:

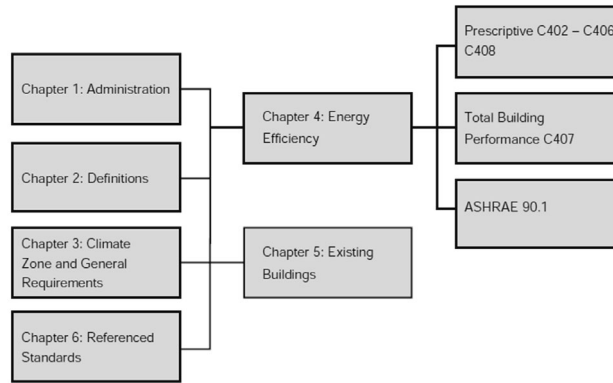
1. **Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. **Total Building Performance.** The Total Building Performance option requires compliance with Section C407.

**Exception:** Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

**C401.2.2 ASHRAE 90.1.** Commercial buildings shall comply with the requirements of ANS/ASHRAE/IESNA 90.1.

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# Compliance Path Options Continued



C401.2

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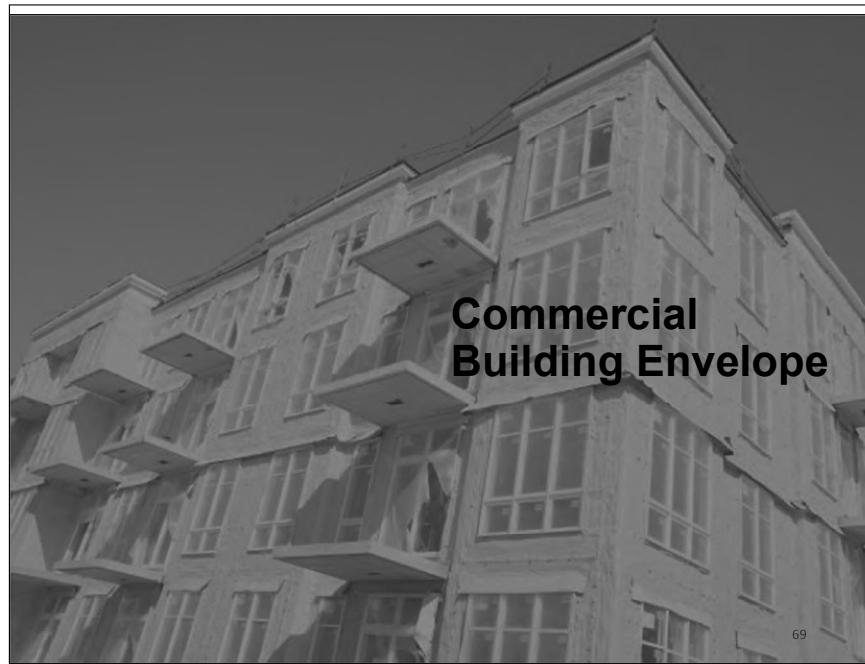
## C401.3 Thermal Envelope Certificate

2021

- Permanent thermal envelope certificate
  - R-values of insulation
  - U-factors and SHGCs of fenestration
  - Envelope air leakage test results
- Completed by approved party
- Posted in approved location and copy included in construction files for project

Energy Efficiency Certificate			
Code edition	<input type="text"/>		
Compliance path	<input type="text"/>		
Insulation Rating		R-Value	R-Value
Ceiling/Roof	R:	<input type="text"/>	R:
Walls	Frame	R:	Mass
	Basement	R:	Crawl space
Floors	Over unconditioned space	R:	Slab edge
Ducts	Attic	R:	Other
		R:	R:
Air Leakage Test Results			
Envelope testing	ACH <input type="text"/> Pa.	Duct testing	<input type="text"/> cfm/100 ft <sup>2</sup>
Fenestration Rating		NFRC U-Factor	NFRC SHGC
Window	U:	<input type="text"/>	<input type="text"/>
Opaque door	U:	<input type="text"/>	<input type="text"/>
Skylight	U:	<input type="text"/>	<input type="text"/>
Weighted average	U:	<input type="text"/>	<input type="text"/>
Designer/builder	<input type="text"/>		Date <input type="text"/>
This Certificate is to be posted in accordance with Section C401.3 of the International Energy Conservation Code.			

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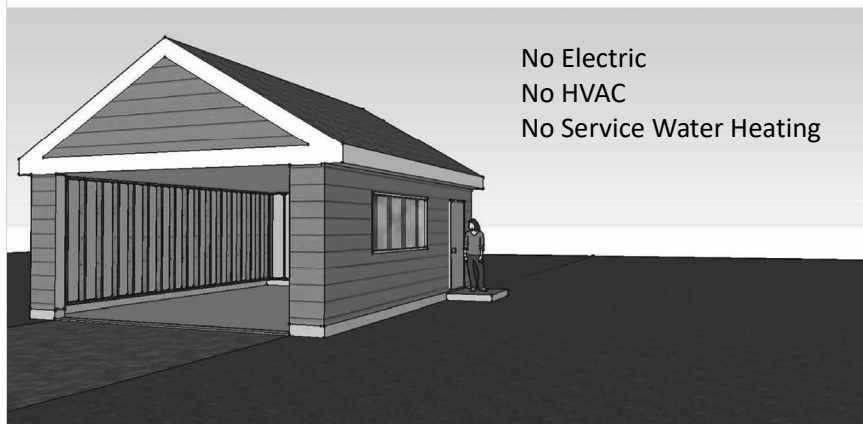
## Key Building Envelope Provisions

- Insulation: roofs, ceilings, above-grade walls, below-grade walls, floors
- Roof solar reflectance and thermal emittance
- Fenestration performance: windows, doors, skylights
- Air leakage and air barriers
- Exempted buildings include low energy buildings, some equipment buildings, some mechanically heated/cooled greenhouses



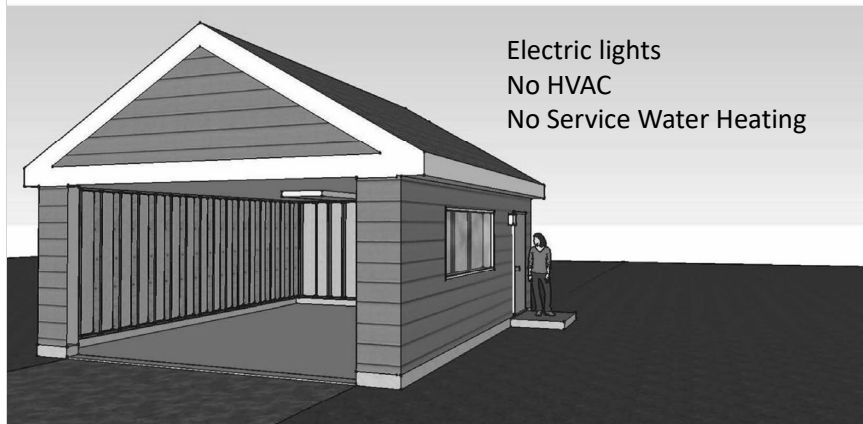
C402

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No Electric  
No HVAC  
No Service Water Heating

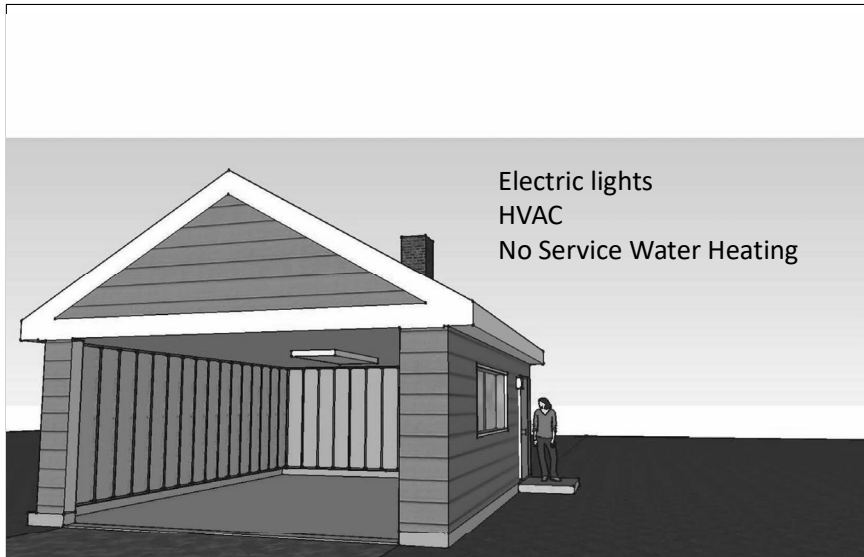
Building is exempt from building envelope requirements.  
No other regulated systems.



Electric lights  
No HVAC  
No Service Water Heating

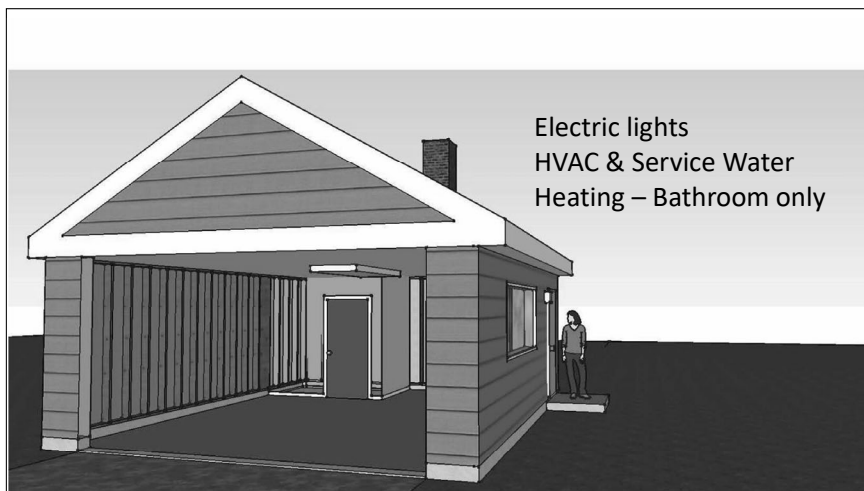
Building is exempt from building envelope requirements.  
Lighting must comply with C405/ R404  
No other regulated systems





Electric lights  
HVAC  
No Service Water Heating

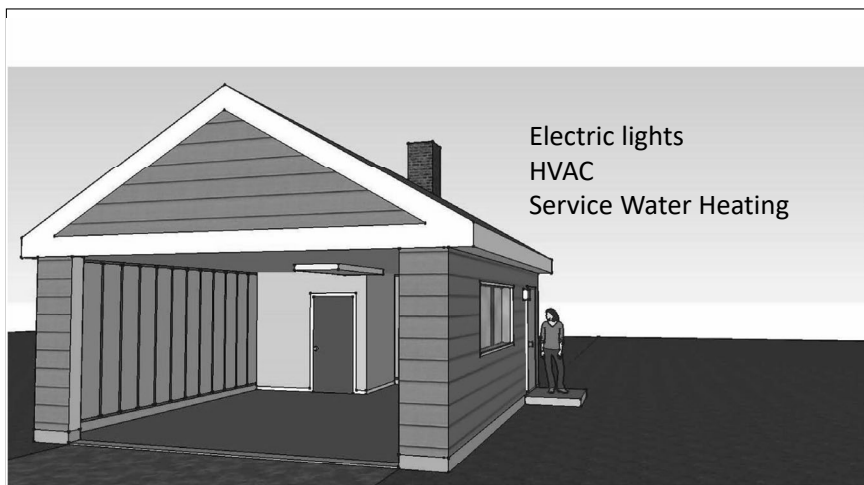
Building Envelope must comply with C402/R402  
Mechanical systems must comply with C403/R403  
Lighting must comply with C405/ R404



Electric lights  
HVAC & Service Water  
Heating – Bathroom only

Bathroom Envelope must comply with C402/R402  
All other regulated systems must comply for entire structure

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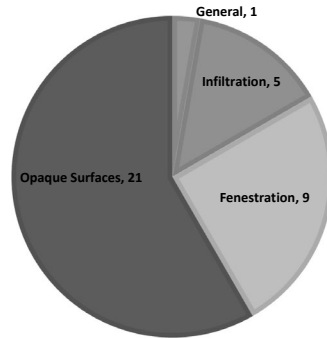
Electric lights  
HVAC  
Service Water Heating

All four regulated systems must comply for entire structure.

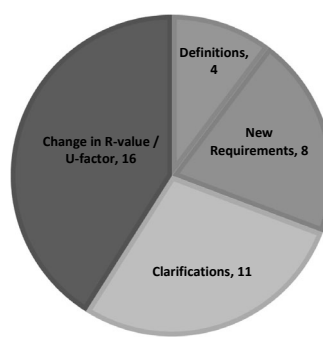
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# 2021 IECC Building Envelope Proposals



PROPOSALS BY COMPONENT



PROPOSALS BY CHANGE TYPE



## Table C402.1.3 Minimum R-Values

**2018**   
**2021** 

### 2018

- R-5 insulation added in all climate zones under heated slabs



### 2021

- R-values for many roof, wall and floor components increased in CZs 4-8
- R-13 insulation for CZ 0 and 1 framed floors
- R-10 continuous insulation for unheated slabs in CZ 3 for Group R buildings
- Doors removed from table

Changes align IECC with ASHRAE 90.1-2016 and 2019 requirements

## Climate Zone 3 – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Oth	Grp R	Other	Grp R
2009	20ci	20ci	13+13	19	38	38	6.3ci	8.3ci	19	30	NR	NR	10, 24" below	10, 24" below
2012	20ci	20ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10ci	30	30	NR	NR	10, 24" below	10, 24" below
2015	25ci	25ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10ci	30	30	NR	NR	10, 24" below	10, 24" below
2018	25ci	25ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10ci	30	30	NR	NR	10, 24" below + R-5 slab	10, 24" below + R-5 slab
2021	25ci	25ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10ci	30	30	NR	10, 24" below	10, 24" below + R-5 slab	10, 24" below + R-5 slab

## Climate Zone 3 – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	7.6ci	9.5ci	19	19	13+3.8ci	13+7.5ci	13	13	NR	NR
2012	7.6ci	9.5ci	13+ 6.5ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	NR	NR
2015	7.6ci	9.5ci	13+ 6.5ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	NR	NR
2018	7.6ci	9.5ci	13+ 6.5ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	NR	NR
2021	7.6ci	9.5ci	13+ 6.5ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	NR	NR

## CZ 4A and 4B – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/ Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Other	Grp R	Other	Grp R
2009	20ci	20ci	13+ 13	19	38	38	10ci	10.4ci	30	30	NR	10, 24" below	15, 24" below	15, 24" below
2012	25ci	25ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10.4ci	30	30	10, 24" below	10, 24" below	15, 24" below	15, 24" below
2015	30ci	30ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10.4ci	30	30	10, 24" below	10, 24" below	15, 24" below	15, 24" below
2018	30ci	30ci	19+ 11 LS	19+ 11 LS	38	38	10ci	10.4ci	30	30	10, 24" below	10, 24" below	15, 24" below + R-5 slab	15, 24" below + R-5 slab
2021	30ci	30ci	19+ 11 LS	19+ 11 LS	49	49	14.6ci	16.7ci	30	30	15, 24" below	15, 24" below	15, 24" below + R-5 slab	15, 24" below + R-5 slab

## Climate Zone 4A and 4B – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	9.5ci	11.4ci	19	19	13+7.5ci	13+7.5ci	13	13+3.8ci	NR	7.5ci
2012	9.5ci	11.4ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	7.5ci	7.5ci
2015	9.5ci	11.4ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	7.5ci	7.5ci
2018	9.5ci	11.4ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	7.5ci	7.5ci
2021	9.5ci	11.4ci	13+13ci	13+14ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+3.8ci or 20	7.5ci	10ci

## CZ 5 and 4C – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/ Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Other	Grp R	Other	Grp R
2009	20ci	20ci	13+13	19	38	38	10ci	12.5ci	30	30	NR	10, 24" below	15, 24" below	15, 24" below
2012	25ci	25ci	19 + 11 LS	19 + 11 LS	38	49	10ci	12.5ci	30	30	10, 24" below	10, 24" below	15, 36" below	15, 36" below
2015	30ci	30ci	19 + 11 LS	19 + 11 LS	38	49	10ci	12.5ci	30	30	10, 24" below	10, 24" below	15, 36" below	15, 36" below
2018	30ci	30ci	19 + 11 LS	19 + 11 LS	38	49	10ci	12.5ci	30	30	10, 24" below	10, 24" below	15, 36" Below + R-5 slab	15, 36" Below + R-5 slab
2021	30ci	30ci	19 + 11 LS	19 + 11 LS	49	49	14.6ci	16.7ci	30	30	15, 24" below	20, 24" below	15, 36" Below + R-5 slab	15, 36" Below + R-5 slab

## Climate Zone 5 and 4C – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	11.4ci	13.3ci	13+5.6ci	13+5.6ci	13+7.5ci	13+7.5ci	13+3.8ci	13+3.8ci	7.5ci	7.5ci
2012	11.4ci	13.3ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2015	11.4ci	13.3ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2018	11.4ci	13.3ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+3.8ci or 20	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2021	11.4ci	13.3ci	13+14ci	13+14ci	13+10ci	13+10ci	13+7.5ci or 20 +3.8ci	13+7.5ci or 20 +3.8ci	7.5ci	10ci

## CZ 6 – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/ Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Other	Grp R	Other	Grp R
2009	20ci	20ci	13+19	19	38	38	12.5ci	14.6ci	30	30	10, 24" below	15, 24" below	15, 24" below	20, 48" below
2012	30ci	30ci	25 + 11 LS	25 + 11 LS	49	49	12.5ci	12.5ci	30	30	10, 24" below	15, 24" below	15, 36" below	20, 48" below
2015	30ci	30ci	25 + 11 LS	25 + 11 LS	49	49	12.5ci	12.5ci	30	30	10, 24" below	15, 24" below	15, 36" below	20, 48" below
2018	30ci	30ci	25 + 11 LS	25 + 11 LS	49	49	12.5ci	12.5ci	30	30	10, 24" below	15, 24" below	15, 36" below + R-5 slab	20, 48" Below + R-5 slab
2021	30ci	30ci	25 + 11 LS	30 + 11 LS	49	49	16.7ci	16.7ci	38	38	20, 24" below	20, 48" below	15, 36" Below + R-5 slab	20, 48" Below + R-5 slab

## Climate Zone 6 – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	13.3ci	15.2ci	13+5.6ci	13+5.6ci	13+7.5ci	13+7.5ci	13+7.5ci	13+7.5ci	7.5ci	7.5ci
2012	13.3ci	15.2ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2015	13.3ci	15.2ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2018	13.3ci	15.2ci	13+13ci	13+13ci	13+7.5ci	13+7.5ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	7.5ci	7.5ci
2021	13.3ci	15.2ci	13+14ci	13+14ci	13+ 12.5ci	13+ 12.5ci	13+7.5ci or 20 +3.8ci	13+7.5ci or 20 +3.8ci	10ci	15ci

## CZ 7 – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/ Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Other	Grp R	Other	Grp R
2009	25ci	25ci	13+19	19+10	38	38	15ci	16.7ci	30	30	15, 24" below	15, 24" below	20, 24" below	20, 48" below
2012	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	15, 24" below	20, 24" below	20, 48" below
2015	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	15, 24" below	20, 24" below	20, 48" below
2018	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	15, 24" below	20, 48" Below + R-5 slab	20, 48" Below + R-5 slab
2021	35ci	35ci	30 + 11 LS	30 + 11 LS	60	60	20.9ci	20.9ci	38	38	20, 24" below	20, 48" below	20, 48" Below + R-5 slab	20, 48" Below + R-5 slab

## Climate Zone 7 – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	15.2ci	15.2ci	19+5.6ci	19+5.6ci	13+7.5ci	13+ 15.6ci	13+7.5ci	13+7.5ci	7.5ci	10ci
2012	15.2ci	15.2ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 15.6ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	10ci	10ci
2015	15.2ci	15.2ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 15.6ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	10ci	10ci
2018	15.2ci	15.2ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 15.6ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	10ci	10ci
2021	15.2ci	15.2ci	13+17ci	13+ 19.5ci	13+ 12.5ci	13+ 15.6ci	13+7.5ci or 20+3.8ci	13+7.5ci or 20+3.8ci	15ci	15ci


## CZ 8 – Roof and Floors

IECC Edition	Roofs						Floors				Slab-on-grade Floors			
	Entirely Above Roof Deck		Metal Buildings		Attic and Other		Mass		Joist/Framing		Unheated Slabs		Heated Slabs	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Oth	Grp R	Other	Grp R	Other	Grp R
2009	25ci	25ci	11+19	19+10	49	49	15ci	16.7ci	30	30	15, 24" below	20, 24" below	20, 48" below	20, 48" below
2012	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	20, 24" below	20, 48" below	20, 48" below
2015	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	20, 24" below	20, 48" below	20, 48" below
2018	35ci	35ci	30 + 11 LS	30 + 11 LS	49	49	15ci	16.7ci	30	30	15, 24" below	20, 24" below	20, 48" Below + R-5 slab	20, 48" Below + R-5 slab
2021	35ci	35ci	25 + 11 + 11 LS	25 + 11 + 11 LS	60	60	23ci	23ci	38	38	20, 48" below	25, 48" below	20, 48" Below + R-5 slab	20, 48" Below + R-5 slab

## Climate Zone 8 – Walls

IECC Edition	Above Grade								Below Grade	
	Mass		Metal Building		Metal Framed		Wood Framed and Other		Below-grade wall	
	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R	Other	Grp R
2009	25ci	25ci	19+5.6ci	19+5.6ci	13+7.5ci	13+ 18.8ci	13+ 15.6ci	13+ 15.6ci	7.5ci	12.5ci
2012	25ci	25ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 17.5ci	13+ 15.6ci or 20+10ci	13+ 15.6ci or 20+10ci	10ci	12.5ci
2015	25ci	25ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 17.5ci	13+ 15.6ci or 20+10ci	13+ 15.6ci or 20+10ci	10ci	12.5ci
2018	25ci	25ci	13+13ci	13+ 19.5ci	13+7.5ci	13+ 17.5ci	13+ 15.6ci or 20+10ci	13+ 15.6ci or 20+10ci	10ci	12.5ci
2021	25ci	25ci	13+ 19.5ci	13+ 19.5ci	13+ 18.8ci	13+ 18.8ci	13+ 18.8ci	13+ 18.8ci	15ci	15ci

### Table C402.1.4 U-factor Criteria

**2018**   
**2021** 

#### 2018

- Separate sections for below-grade wall insulation and opaque doors

#### 2021

- U-factors for many roof, wall and floor assemblies increased in CZs 4-8
- F-factors for heated slabs corrected
  - One value now shown
- Doors U-factors consolidated to this table

TABLE C402.1.4 Opaque Thermal Envelope Assembly Maximum Requirements, U-Factor Method<sup>b</sup>

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
<b>Roofs</b>																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	<del>U-0.044</del> U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.029	U-0.029	U-0.029	U-0.026	U-0.026
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	<del>U-0.027</del> U-0.021	<del>U-0.027</del> U-0.021	<del>U-0.027</del> U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.017	U-0.017	U-0.017
<b>Walls, above grade</b>																
Mass <sup>d</sup>	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.066	U-0.066	U-0.066
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	<del>U-0.050</del> U-0.050	<del>U-0.050</del> U-0.050	<del>U-0.050</del> U-0.050	<del>U-0.050</del> U-0.050	<del>U-0.050</del> U-0.050	U-0.041	U-0.039	U-0.039	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.049	U-0.049	U-0.049	U-0.042	U-0.042	U-0.042
Wood framed and other <sup>e</sup>	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.052	U-0.052
<b>Walls, below grade</b>																
Below-grade wall <sup>f</sup>	C-1.140 <sup>g</sup>	C-1.140 <sup>g</sup>	C-1.140 <sup>g</sup>	C-1.140 <sup>g</sup>	C-1.140 <sup>g</sup>	C-1.140 <sup>g</sup>	C-0.119	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092	<del>C-0.119</del> C-0.092
<b>Floors</b>																
Mass <sup>d</sup>	U-0.322 <sup>h</sup>	U-0.322 <sup>h</sup>	U-0.107	U-0.087	<del>U-0.070</del> U-0.074	<del>U-0.070</del> U-0.074	<del>U-0.070</del> U-0.057	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.051	<del>U-0.074</del> U-0.042	<del>U-0.074</del> U-0.038	<del>U-0.074</del> U-0.038
Joist/framing	U-0.066 <sup>h</sup>	U-0.066 <sup>h</sup>	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027
<b>Slab-on-grade floors</b>																
Unheated slabs	F-0.73 <sup>i</sup>	F-0.73 <sup>i</sup>	F-0.73 <sup>i</sup>	F-0.73 <sup>i</sup>	F-0.73 <sup>i</sup>	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.40	F-0.40	F-0.40
Heated slabs <sup>j</sup>	<del>F-1.00</del> 0.74	<del>F-1.00</del> 0.74	<del>F-1.00</del> 0.74	<del>F-1.00</del> 0.74	<del>F-0.90</del> 0.74	<del>F-0.90</del> 0.74	<del>F-0.86</del> 0.64	<del>F-0.86</del> 0.64	<del>F-0.79</del> 0.64	<del>F-0.79</del> 0.64	<del>F-0.79</del> 0.64	<del>F-0.79</del> 0.64	<del>F-0.79</del> 0.64	<del>F-0.60</del> 0.55	<del>F-0.60</del> 0.55	<del>F-0.60</del> 0.55
<b>Opaque doors</b>																
Nonswinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31
Swinging door <sup>k</sup>	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37	<del>U-0.61</del> U-0.37
Garage door <14% glazing <sup>l</sup>	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

# C402.1.4.1 Roof/Ceiling Assembly

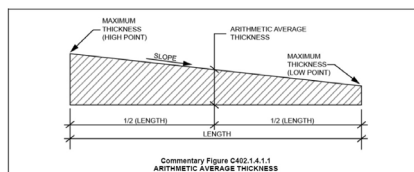
## C402.2.1 Roof Assembly



- 2018: Section reformatted and language added clarifying that continuous insulation is not less than 2 layers and joint edges are staggered
- 2021: Roof insulation requirements clarified and separated for compliance with either the U-factor or R-value method

# Roof Assembly and Insulation

- Requirements clarify U-factor and R-value compliance options
  - How R-value of tapered roof insulation is determined
    - Sloped roof insulation R-value contribution – determine using the average thickness in inches along with the material R-value-per-inch
  - Minimum thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, must be at least 1 inch
  - Insulation on suspended ceilings does not count towards roof insulation requirements
  - Continuous insulation must be installed in at least two layers with staggered joints



C402.1.4.1 and C402.2.1

## C402.2.2 Above-Grade Walls

- Added language “except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the U-factor of concrete masonry units with integral insulation shall be permitted.”

## C402.2.3 Floors

- Added language providing parameters for weight of mass walls
- Mirrors the mass wall language in above-grade walls section

## Roof Solar Reflectance and Thermal Emittance

- Low-sloped roofs directly above cooled conditioned spaces in Climate Zones 0 through 3 must comply with one or more of the options in Table C402.3

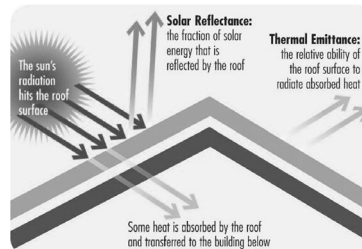


TABLE C402.3  
MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS\*

Three-year-aged solar reflectance index <sup>b</sup> of 0.55 and 3-year aged thermal emittance <sup>c</sup> of 0.75
Three-year-aged solar reflectance index <sup>d</sup> of 64



# Roof Solar Reflectance and Thermal Emittance Continued

Exceptions:

- Portions of the roof that include or are covered by
  - PV systems or components
  - Solar air or water-heating systems or components
  - Vegetative roofs or landscaped roofs
  - Above-roof decks or walkways
  - Skylights
  - HVAC systems and components
- Portions of roof shaded during peak sun angle on summer solstice by permanent features
- Portions of roofs that are ballasted
- Roofs were at least 75% of the area complies with one or more exceptions



Vegetative roof: an assembly of interacting components designed to waterproof a building's top surface that includes, by design, vegetation and related landscape elements

C402.3

# Table C402.4 U-factor and SHGC Requirements

- Changes to the U-factor and SHGC requirements in Table C402.4 increase the energy efficiency of windows, doors and skylights
- The table is revised to eliminate orientation and classify SHGC on the operable/fixed properties of the fenestration

# Table C402.4 U-factor and SHGC Requirements

TABLE C402.4 Building Envelope Fenestration Maximum U-Factor and SHGC Requirements

CLIMATE ZONE	0-1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Vertical fenestration																
U-factor																
Fixed fenestration	0.50		0.50 <del>0.45</del>		0.46 <del>0.42</del>		0.40 <del>0.36</del>		0.36 <del>0.36</del>		0.36 <del>0.34</del>		0.29		0.29 <del>0.26</del>	
Operable fenestration	0.45 <del>0.62</del>		0.45 <del>0.60</del>		0.44 <del>0.51</del>		0.45		0.45		0.44 <del>0.42</del>		0.40 <del>0.36</del>		0.37 <del>0.32</del>	
Entrance doors	1.10 <del>0.83</del>		0.89 <del>0.77</del>		0.77 <del>0.68</del>		0.77 <del>0.63</del>		0.77 <del>0.63</del>		0.77 <del>0.63</del>		0.77 <del>0.63</del>		0.77 <del>0.63</del>	
SHGC																
Orientation <sup>a</sup>	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable	SEW Fixed	N Operable
PF < 0.2	0.25 0.23	0.33 0.21	0.25	0.33 <del>0.23</del>	0.25	0.33 <del>0.23</del>	0.36	0.40 0.33	0.38	0.51 0.33	0.40 0.38	0.50 0.34	0.45 0.40	NR	0.45 0.36	N <del>0.36</del>
0.2 < PF < 0.5	0.30 0.28	0.37 0.25	0.30	0.37 0.28	0.30	0.37 0.28	0.43	0.53 0.40	0.46	0.56 <del>0.40</del>	0.48 0.46	0.50 0.41	NR	NR <del>0.43</del>	NR 0.48	NR <del>0.43</del>
PF ≥ 0.5	0.40 0.37	0.40 0.34	0.40	0.40 0.37	0.40	0.40 0.37	0.58	0.56 0.53	0.61	0.64 <del>0.53</del>	0.64 0.61	0.64 0.54	NR	NR <del>0.64</del>	NR 0.64	NR <del>0.64</del>
Skylights																
U-factor	0.75 <del>0.70</del>		0.65		0.55		0.50		0.50		0.50		0.50 <del>0.44</del>		0.50 <del>0.41</del>	
SHGC	0.35 <del>0.30</del>		0.35 <del>0.30</del>		0.35 <del>0.30</del>		0.40		0.40		0.40		NR		NR	

# Fenestration Clarifications & Definitions **2018**

- Editorial change to add *daylight* to the terms sidelit zones and toplit zones
- Section C405.2.3 (Light-reduction controls), redundant text removed and renumbered to clarify the entire list of exceptions apply
- Skylight requirements in Section C402.4.1.2 (Increased skylight area with daylight responsive controls) and Section C402.4.2 (Minimum skylight fenestration area) edited with more clear and direct language
  - Minimum requirements for Tubular Daylighting Devices added to Section C402.4.2, reference to NFRC 203 for tubular skylights
  - Exception added to Section C402.4.2 for storm shelters complying with ICC 500

# **2018** **C402.4.4 Daylight Zones**



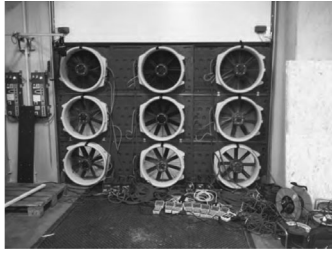
- This new language provides reference to daylighting controls in Sections C405.2.3.2 and C405.2.3.3

# **2018** **2021** **C402.4.5 Doors**

- New language provides differentiation between swinging doors and all other doors
  - Opaque swinging doors are addressed in Table C402.1.4
  - Nonswinging horizontally hinged with single row of fenestration U-factors specified
    - 0.440 in CZs 0 through 6
    - 0.360 in CZs 7 and 8
    - Fenestration area between 14% and 25% of total door area



## C402.5 Air Leakage



- Air leakage requirements are expanded to include provisions for residential and non-residential air leakage testing and building envelope performance verification for buildings not tested
- Section C402.5.3 provides reasonable options for mitigating air leakage when the rate is greater than allowed in the code

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## Air Leakage

- **C402.5 Air leakage—thermal envelope.** The building thermal envelope shall comply with Sections C402.5.1 through Section C402.5.11.1, or the building thermal envelope shall be tested in accordance with Section C402.5.2 or C402.5.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.7, C402.5.8 and C402.5.9.
  - Air intakes, exhaust openings, stairways and shafts
  - Loading dock weather seals
  - Vestibules

This language picks up Section C402.5.1.2 Air barrier compliance

- Requires testing

C402.5

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## Air Barrier Testing – Group R and I

- Buildings with Group R and I occupancies must be tested using the **dwelling and sleeping unit enclosure testing** method
  - Required in all CZ except 2B, 3C and 5C
  - Adds new definition of testing unit enclosure area
  - Building thermal envelope must be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method
  - Air leakage limited to 0.30 cfm/ft<sup>2</sup> of testing unit enclosure area at 50 Pa

**TESTING UNIT ENCLOSURE AREA.** The area sum of all the boundary surfaces that define the *dwelling unit, sleeping unit* or occupiable *conditioned space* including top/ceiling, bottom/floor and all side walls. This does not include interior partition walls within the *dwelling unit, sleeping unit*, or occupiable *conditioned space*. Wall height shall be measured from the finished floor of the *conditioned space* to the finished floor or roof/ceiling air barrier above.

C402.5.1.2 and C402.5.2

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## Air Barrier Testing – Group R and I **2021**

### Continued

- Where multiple dwelling/sleeping units or other occupiable conditioned spaces are contained within one building thermal envelope, each unit must be tested separately with an unguarded blower door test
  - The building air leakage is the weighted average of all testing unit results, weighted by each testing unit's enclosure area
  - 8 or less units, test them all
  - 8 or more units, test the greater of 7 units or 20 percent of all units
    - Top floor unit, ground floor unit, unit with largest area
    - For each unit that exceeds maximum air leakage rate (fails), test two more

C402.5.1.2 and C402.5.2

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## Air Barrier Testing - All Other **2021**

### Occupancies

- Buildings or portions of buildings other than Group R and I occupancies must be tested using the **building thermal envelope testing** method
  - Tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent method
  - Air leakage limited to 0.40 cfm/ft<sup>2</sup> of building thermal envelope area at 75 Pa
  - Alternatively, portions of the building can be tested and measured air leakage area weighted
    - Entire envelope area of all stories that have any spaces directly under a roof
    - Entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade
    - Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space

C402.5.1.2 and C402.5.3

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## Air Barrier Testing - All Other **2021**

### Occupancies Continued

- If the building air leakage rate exceeds 0.40 cfm/ft<sup>2</sup> but does not exceed 0.60 cfm/ft<sup>2</sup>
  - Diagnostic evaluation using smoke tracer or infrared imaging while building is pressurized required along with a visual inspection of the air barrier
    - Any leaks noted must be sealed where such sealing can be made without destruction of existing building components
    - A report identifying corrective actions taken to seal leaks must be submitted to the code official and building owner
    - Building is deemed to comply, no retest required

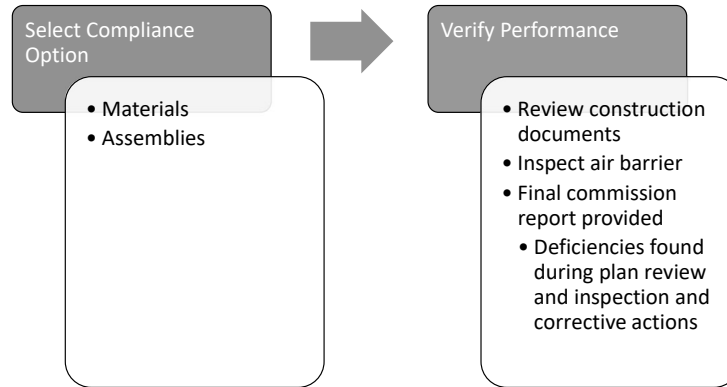
#### Exceptions:

- Buildings in CZ 2B, 3B, 3C and 5C
- Buildings larger than 5,000ft<sup>2</sup> in CZ 0B, 1, 2A, 4B and 4C
- Buildings between 5,000ft<sup>2</sup> and 50,000ft<sup>2</sup> in CZs 0A, 3A and 5B

C402.5.1.2 and C402.5.3

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## 2021 Buildings Exempt From Air Barrier Testing



C402.5.1.2 and C402.5.1.5

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## 2018 C402.5.3 Rooms containing fuel-burning appliances

- The room or space containing fuel-burning appliances must be either outside the building thermal envelope or enclosed and isolated from conditioned spaces inside the building thermal envelope.



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## 2021 C402.5.11 and C403.14 Operable Openings Interlocking

- Large, operable openings (>40ft<sup>2</sup>) such as roll-up doors and windows must now be interlocked with the heating and cooling system
- Time and temperature specific
  - System adjustments within 10 minutes of opening operable opening
  - Controls raise cooling setpoint to 90°F and lower heating setpoint to 55°F
  - Controls shut off the system entirely when outdoor temperatures are below 90°F or above 55°F



C402.5.11 and C403.14

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# Operable Openings Interlocking Continued



- Exceptions
- Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy
  - Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official
  - The first entrance doors where located in the exterior wall and are part of a vestibule system



## Key Mechanical System Provisions

- Heating and cooling load calculations and system design
- Equipment efficiencies and sizing
- System controls
- Economizers
- Ventilation and exhaust systems
- Fans and fan controls
- Refrigeration equipment performance
- Duct construction
- Piping insulation



## C403.1.2 Data Centers



- Comply with Sections 6 and 8 of ASHRAE 90.4 but must follow mechanical load component tables provided in IECC Section C403.1.2

TABLE C403.1.2(1) MAXIMUM DESIGN MECHANICAL LOAD COMPONENT (DESIGN MLC)	
CLIMATE ZONE	DESIGN MLC AT 100% AND AT 50% ITE LOAD
0A	0.24
0B	0.26
1A	0.23
2A	0.24
3A	0.23
4A	0.23
5A	0.22
6A	0.22
1B	0.28
2B	0.27
3B	0.26
4B	0.23
5B	0.23

TABLE C403.1.2(2) MAXIMUM ANNUALIZED MECHANICAL LOAD COMPONENT (ANNUALIZED MLC)	
CLIMATE ZONE	HVAC MAXIMUM ANNUALIZED MLC AT 100% AND AT 50% ITE LOAD
0A	0.19
0B	0.20
1A	0.18
2A	0.19
3A	0.18
4A	0.17
5A	0.17
6A	0.17
1B	0.16
2B	0.18
3B	0.18
4B	0.18
5B	0.16

## C403.2.3 Fault Detection and Diagnostics

- HVAC systems serving a gross conditioned floor area of >100,000 ft<sup>2</sup> must include FDD system
- The system must include permanently installed sensors to measure HVAC system performance



Exception: R-1 and R-2 occupancies

## C403.2.1 Zone isolation

- Renumbered in 2021 IECC
- Systems serving *zones* designed to operate or be occupied non-simultaneously
  - Over 25,000 ft<sup>2</sup> floor area
  - Span more than one floor
- Divided into isolation areas
- Controlled independently
- 3 important exceptions



## **C403.3.2, C403.11 Equipment Performance Requirements**

- Equipment must meet the minimum efficiency requirements of Tables C403.3.2(1) - (16)
  - HVAC equipment efficiency updated to match ASHRAE tables directly and Federal appliance manufacturing requirements
  - Additional tables added for
    - DOAS units
    - Water source heat pumps
    - Variable refrigerant flow cooling and heat pumps
    - Heat pump and heat reclaim chiller packages
    - Ceiling mounted computer room air conditioners
    - Commercial refrigerators and freezers
  - Refrigeration efficiencies updated to match federal requirements

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## **C403.4.1.2 Deadband**

- **C403.4.1.2 Deadband**

Control language revised to “configured” rather than “capable of being configured”

- **C403.4.1.3 Setpoint overlap restriction**

Control language revised to “configured” rather than “capable of being configured”



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## **C403.4.1.4 Heated or Cooled Vestibules**

- This new section specifies that if a vestibule is heated or cooled, a thermostat must be provided and configured to shut off when outdoor temperatures are above 45 degrees, and set points are not greater than 60 degrees or cooler than 85 degrees.

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## C403.4.1.5 Hot Water Boiler Outdoor Temperature Setback Control **2018**

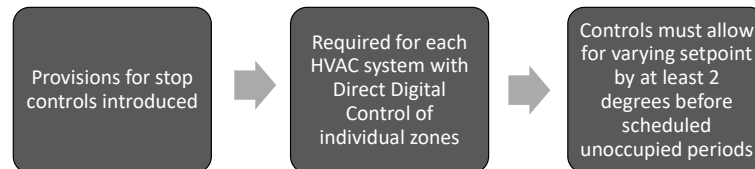
- Requires an outdoor setback control for hot water boilers supplying heat to the building through one- or two-pipe heating systems
- Must lower the boiler water temperature based on the outdoor temperature



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## C403.4.2.3 Automatic Start and Stop **2021**

- In addition to automatic start controls, HVAC systems with direct digital controls serving individual zones must have automatic stop controls





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## C403.5 Economizers **2018** **2021**

- 2018: Section C403.3 significantly reformatted to bring together all requirements for economizers in the same location regardless of the HVAC system type (i.e., simple or complex). Requirements for air and water economizers are outlined. Exceptions are the same for either economizer type
- 2021: Exception 7 added
  - VRF systems installed with a dedicated outdoor air system

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## C403.5.5 Economizer fault detection and diagnostics

2018   
2021 

- Renumbered in 2021 IECC
- Some air conditioners must be equipped with economizers
- FDD required
  - Temperature sensors
  - Refrigerant pressure sensors
  - Unit controller
  - Unit fault reporting



## C403.7.7 Shutoff dampers

2018   
2021 

- The motorized damper requirement has been expanded to include permissible air leakage, sequence of operation, and locations that had previously been covered under the subsections to C402.4.5, air intakes, exhaust openings, stairways and shafts.
- Exception added for new CZ 0

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## C403.13.2 Snow- and Ice-melt System Controls

2018 

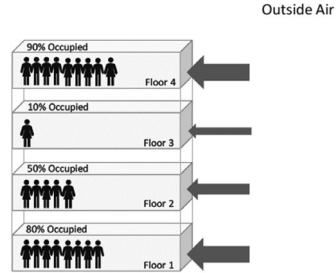
- This section now applies to all snow- and ice-melt systems, not only those supplied through the energy service to the building
  - Automatic controls configured to shut off the system when the pavement temperature is above 50°F and precipitation is not falling
  - Automatic or manual control configured to shut off when the outdoor temperature is above 40°F



126

## C403.7.1 Demand Control Ventilation

- Required for all single-zone systems required to comply with Sections C403.5 through C403.5.3
  - Economizers
- Required for spaces larger than 500 ft<sup>2</sup> and with an average occupant load of at 15 people or greater per 1,000 ft<sup>2</sup> of floor area
- Served by systems with
  - Air-side economizer
  - Automatic modulating control of the outdoor air damper
  - Design outdoor airflow greater than 3,000 cfm



Note several new/modified exceptions in 2021 IECC

C403.7.1

127

## C403.7.2 Enclosed parking garage ventilation controls

- Garages storing or handling automobiles
- Carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors
- Ventilation optimization controls to modulate airflow
  - Exceptions:
    - total exhaust capacity < 8,000 cfm & no heating or mechanical cooling
    - Ventilation system motor nameplate power ratio exceeding 1,125 ft<sup>2</sup>/hp



128

## C403.7.4 Energy Recovery Systems

Requirements for two separate categories

- Nontransient dwelling units (apartments)
  - New exhaust energy recovery requirements in dwelling units occupied for more than 30 days
  - Requires 50% cooling recovery, 60% heating recovery
  - Exceptions
    - CZ 3C and small dwelling units (<500ft<sup>2</sup>) in CZs 0B, 1, 2, 3, 4C, 5C
    - Warm climate zones exempt from heating energy recovery requirements
    - Cooler climate zones exempt from cooling energy recovery requirement
- Spaces other than nontransient dwelling units
  - Very few changes

**ENTHALPY RECOVERY RATIO.** Change in the enthalpy of the *outdoor air* supply divided by the difference between the *outdoor air* and entering exhaust air enthalpy, expressed as a percentage.

C403.7.4

129

2018 

## C403.7.5 Kitchen exhaust systems

- Updated in 2018
- Regulates efficiency and maximum exhaust rates
- Makeup  $\leq$  10% exhaust
- Hoods  $>$  5,000 cfm
  - Factory-built, tested hoods
- Table C403.7.5 specifies max exhaust rates




130

2021 

## C403.8.3 Fan Efficiency

- Fan Energy Index (FEI) replaces Fan Efficiency Grade (FEG) metric
- FEI is defined; FEI  $>$  1.00 for covered fans; ratings from approved third-party lab
- FEI includes effects (losses) of motors and drives, if sold with fan; otherwise, FEI ratings for bare fan include default motor/drive losses
- Sizing / selection window eliminated
  - “15 percentage points from peak total efficiency “--- difficult to enforce

131

2021 

## C403.8.3 Fan Efficiency Cont'd

- Other changes to C403.8.3 Fan efficiency
  - Exemption removed for powered roof ventilators (PRVs)
  - Refined exemptions for fans sold (embedded) within packages
  - Lower-size limit reduced from 5 HP to 1 HP

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## C403.8.5 Low-Capacity Ventilation Fans

- Requirements for low-capacity ventilation fans apply the efficiencies of ventilation fans typical of residential construction to mid-rise residential occupancies and small commercial buildings
  - Except when part of listed HVAC appliance
  - Except dryer exhaust, range hood main or booster fans

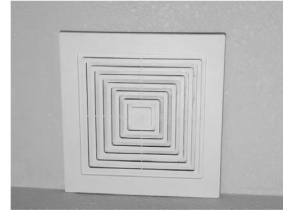


TABLE C403.8.5 Low-Capacity Ventilation Fan Efficacy\*

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIRFLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	1.2 cfm/watt	Any
In-line fan	Any	3.8 cfm/watt	Any
Bathroom, utility room	10	2.8 cfm/watt	< 90
Bathroom, utility room	90	3.5 cfm/watt	Any

## C403.9 Large-Diameter Ceiling Fans

- Large-diameter ceiling fans, as defined in C202, must be tested and labeled in accordance with AMCA 230
- Testing provisions include energy efficiency metric



$$\frac{CFM}{Watt} = \frac{\sqrt{\frac{A F}{\rho}}}{Power\ Used}$$

A=Circular area of fan (diameter)

F=Thrust (difference between hanging weight and weight while running)



P=Density of Air

## C403.12.1 Duct and Plenum Insulation and Sealing

- Supply and return air ducts and plenums
- Unconditioned spaces
  - R-6 insulation
- Outside the building
  - R-8 insulation in CZs 1 – 4
  - R-12 insulation in CZs 5 – 8
- Underground beneath buildings
  - Must be insulated or have an equivalent thermal distribution efficiency



## C403.12.3 Piping Insulation

2018   
2021 

### 2018

- Exception 5 was changed from piping  $\leq 4$  ft to certain pipe fittings with diameters  $\leq 1$ "
- Exception was added for buried piping conveying fluids  $\leq 60$  °F
- Table C403.12.3 significantly expanded
- New Table Footnotes:
  - a. reduction of these thicknesses by 1 inch for piping  $< 1 \frac{1}{2}$ " and located in partitions within conditioned spaces
  - c. Reduction thicknesses by  $1 \frac{1}{2}$ " for direct-buried heating and hot water system piping

### 2021

- Exception added for radiant heating systems
  - Sections of piping intended by design to radiate heat

136

## Table C403.12.3 Minimum Pipe Insulation Thickness (in inches)

2018 

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu × in./ft × ft <sup>2</sup> × °F	Mean Rating Temperature, °F	< 1	1 to < 1½	1½ to < 4	4 to < 8	> 8
> 350	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251–350	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201–250	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141–200	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105–140	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40–60	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

- In 2018, Section C403.12.3.1 codifies the good practice of protecting insulation and prohibits adhesive tapes

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## C403.11 Refrigeration Equipment Performance

2021 

Requirements completely revamped in 2021 IECC

- **C403.11.1 Commercial refrigerators, refrigerator, freezers and refrigeration**
  - Table C403.11.1 when tested and rated in accordance with AHRI Standard 1200
- **C403.11.2 Walk-in coolers and walk-in freezers**
  - Tables C403.11.2.1(1), C403.11.2.1(2) and C403.11.2.1(3)



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## C403.11 Refrigeration Equipment Performance Cont'd

TABLE C403.11.2.1(1)  
WALK-IN COOLER AND FREEZER DISPLAY DOOR  
EFFICIENCY REQUIREMENTS<sup>a</sup>

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) <sup>a</sup>
Display door, medium temperature	DD, M	$0.04 \times A_{dd} + 0.41$
Display door, low temperature	DD, L	$0.15 \times A_{dd} + 0.29$

a.  $A_{dd}$  is the surface area of the display door.

TABLE C403.11.2.1(2)  
WALK-IN COOLER AND FREEZER NONDISPLAY  
DOOR EFFICIENCY REQUIREMENTS<sup>a</sup>

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) <sup>a</sup>
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$
Freight door, medium temperature	FD, M	$0.04 \times A_{nd} + 1.9$
Freight door, low temperature	FD, L	$0.12 \times A_{nd} + 5.6$

a.  $A_{nd}$  is the surface area of the nondisplay door.

## C403.3.3 Hot gas bypass limitation

- Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation.
- The capacity of the hot gas bypass shall be limited as indicated in Table C403.3.3, as limited by Section C403.5.1.

## C403.7.6 Automatic Control of HVAC Systems Serving Guestrooms

- Controls capable of 3 modes of temperature control
  - Rented but unoccupied: automatically raise cooling setpoint and lower the heating setpoint by not less than 4°F from occupant setpoint within 30 minutes after occupants leave
  - Unrented and unoccupied: automatically raise cooling setpoint to not lower than 80°F and lower the heating setpoint to not higher than 60°F. Initiated within 16 hours of the guestroom being
- Occupied, setpoints return to their occupied setpoints once occupancy is sensed





## Commercial Service Water Heating Systems

### Service Water Heating




- Service water heating is the “supply of hot water for purposes other than comfort heating”

#### Key Provisions

- Equipment efficiencies
- Heat traps for hot water storage tanks
- Piping insulation
- Controls
- Heated-water circulating and temperature maintenance systems
- Drain water heat recovery units
- Pools and spas

143

### C404.2.1 High Input Service Water-Heating Systems

**2018**   
**2021** 


- Large (over 1,000,000 Btu/h) service hot water system efficiency increases from 90% to 92%
- Capacity weighted average
- Three exceptions regarding:
  - Site-recovered energy (25%)
  - Individual dwelling units
  - Individual heaters  $\leq 100,000$  BTU/h



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## C404.6.1.1 Demand Recirculation Controls

2018   
2021 

- Pump must have controls that:
  - Start the pump upon hot water demand
  - Limit the temperature of the water entering the cold water piping to 104 °F

**DEMAND RECIRCULATION WATER SYSTEM.** A water distribution system where one or more pumps prime the service hot water piping with heated water upon a demand for hot water.

145

## C408.2 Mechanical Systems and Service Water-Heating System Commissioning and Completion Requirements

2018 

- *Service water-heating systems, swimming pool water-heating systems, spa water-heating systems and the controls for those systems shall be commissioned and completed in accordance with Section C408.2.*



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## Commercial Electrical Power and Lighting Systems

147

# Key Electrical Power and Lighting Provisions

- Lighting controls
- Light reduction methods
- Interior and exterior lighting power
- Automatic receptacle controls
- Energy monitoring




- The lighting requirements apply to the design of:
  - New lighting systems
  - Altered components/systems as part of alteration
  - Change of use

C405

148

## C405.1 General

**2018**   
**2021** 

### 2018


- The section has been reformatted, but remains charging language for all lighting requirements, dwelling units in multi-family buildings comply with R404.1.

### 2021

- *General lighting* requirement
- Lighting for dwelling units
  - No less than 90 percent of permanently installed lighting, excluding kitchen appliance lighting, must have high-efficacy lighting or compliance with Section C405.2.4 and C405.3

149



## C405.2 Lighting Controls

**2018**   
**2021** 

- Lighting systems shall be provided with controls that comply with one of the following:
  1. Lighting controls as specified in Sections C405.2.1 through C405.2.7
  2. Luminaire light level controls (LLLC) and lighting controls as specified in Sections C405.2.1, and C405.2.5 and C405.2.6.

150

### C405.2.1.3 Occupant Sensor Control Function in Open Plan Office Areas

**2018**   
**2021** 

- Small open plan offices (300 ft<sup>2</sup> or less)
  - Comply with occupancy sensor requirements in C405.2.1.1
- Larger open plan offices
  - General lighting controlled separately in zones less than 600ft<sup>2</sup>
  - General lighting in each control zone permitted to automatically turn on upon occupancy
    - General lighting in other unoccupied zones within the open plan permitted to turn on to not more than 20 percent of full power or remain unaffected
  - Controls automatically turn off general lighting within 20 minutes after all occupants have left
  - General lighting in each control zone must turn off or uniformly reduce lighting power to an unoccupied setpoint of not more than 20 percent of full power within 20 minutes after all occupants have left

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### C405.2.1.2 Occupant Sensor Controls in Warehouse Storage Areas

**2021** 



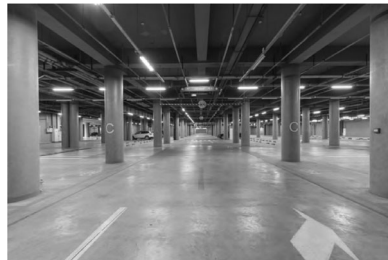
- Lighting in aisleway must be independent
- Time delay for occupants leaving the warehouse area and turning off or reducing the lighting is 20 minutes
- Occupancy sensor or time-switch control required

152

### C405.2.8 Parking Garage Lighting Control



**2021** 

- A new provision for lighting in parking garages recognizes parking garages as a unique space and requires such spaces to have either occupant sensors or time-switch controls.



153

## C405.2.4.1 Daylight-Responsive Control Function

2018   
2021 

- Lighting in toplit zones must be controlled separately from sidelit daylight zones
- Lighting in primary sidelit zones must be controlled separate from lights in secondary sidelit daylight zones
- Continuous dimming to 15%
- Capability for complete shutoff of lights
- When occupant sensor controls have reduced the lighting power to an unoccupied setpoint, daylight responsive controls must continue to adjust electric light levels in response to available daylight, but be configured to not increase the lighting power
- Exemptions:
  - 150 watts of lighting in primary sidelit daylight zone permitted to be controlled together with lighting in a primary sidelit daylight zone facing a different cardinal orientation
  - 150 watts of lighting in secondary sidelit daylight zone permitted to be controlled together with lighting in a secondary sidelit daylight zone facing a different cardinal orientation

154


## C405.2.7 Exterior lighting controls

2018 

- The section was rewritten to clarify the scope. It requires all exterior lighting to comply except for very specific types, and it provides more guidance on control requirements.
- The exterior lighting controls section has been expanded to reference daylight shutoffs, decorative lighting shutoff, lighting setbacks, and exterior time-switch controls.

155

## Interior Lighting Power Allowances: Building Area Method

2021 

- Most LPD values decreased
- A small number of building type LPD values increased

Building Area Type	LPD (w/ft <sup>2</sup> )
Automotive facility	<del>0.71</del> 0.75
Convention center	<del>0.76</del> 0.64
Courthouse	<del>0.90</del> 0.79
Dining: bar lounge/leisure	<del>0.90</del> 0.80
Dining: cafeteria/fast food	<del>0.79</del> 0.76
Dining: family	<del>0.78</del> 0.71
Dormitory	<del>0.61</del> 0.53
Exercise center	<del>0.65</del> 0.72
Fire station	<del>0.53</del> 0.56
Gymnasium	<del>0.68</del> 0.76
Health care clinic	<del>0.82</del> 0.81

C405.3.2(1)

(continued)

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## Interior Lighting Power Allowances: Space by Space

- Most LPD values decreased
- A few space type LPD values increased

Space Type	LPD (w/ft <sup>2</sup> )
Food preparation area	<del>1.06</del> 1.09
Guestroom	<del>0.77</del> 0.41
Laboratory	
In or as a classroom	<del>1.20</del> 1.11
Otherwise	<del>1.45</del> 1.33
Laundry / washing area	<del>0.43</del> 0.53
Loading dock, interior	<del>0.58</del> 0.88
Lobby	
For an elevator	<del>0.68</del> 0.65
Visually impaired facility	<del>2.03</del> 1.69
In a hotel	<del>1.06</del> 0.51

C405.3.2(2)

(continued)

157

## C405.4 Lighting for Plant Growth



- At least 95% of permanently installed luminaires used for plant growth and maintenance must have a photon efficiency of not less than 1.6  $\mu\text{mol}/\text{J}$
- ANSI/ASABE S640

158

## C405.11 Automatic Receptacle Control



- New provisions require at least 50 percent of the covered receptacles and 25 percent of branch circuit feeders to be automatically controlled receptacles
- Multiple control options
- All controlled receptacles must be permanently marked per NFPA 70

159

## C405.12 Energy Monitoring

- Applies to new buildings 25,000 ft<sup>2</sup> or larger
- Must be equipped to measure, monitor, record and report energy consumption data
  - **Exception:** R-2 occupancies and individual tenant spaces if the space has its own utility services and meters and has less than 5,000 ft<sup>2</sup>

TABLE C405.12.2 ENERGY USE CATEGORIES	
LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in an HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.



## C406 Additional Efficiency Requirements

- Revised structure of C406
  - Points-based
  - 10 points required
  - Equity of efficiency options across climate zones
- Expanded options
  - 11 options total, 3 new



## Additional Energy Efficiency Credit Options

1. More efficient HVAC performance
2. Reduced lighting power
3. Enhanced lighting controls
4. On-site supply of renewable energy
5. Dedicated outdoor air systems
6. High-efficiency service water heating
7. Enhanced envelope performance
8. Reduced air infiltration
9. *Energy monitoring system*
10. *Fault detection and diagnostics*
11. *Efficient kitchen equipment*

C406.1

163

## 2021 Changes to Credit Options: HVAC and Lighting Power

### Option 1: More Efficient HVAC Equipment Performance

- 5% heating efficiency improvement
- 5% cooling efficiency improvement
- 10% heating efficiency improvement
- 10% cooling efficiency improvement
- More than 10% cooling efficiency improvement (use equation)

### Option 2: Reduced Lighting Power

- Reduced lighting power by more than 10%
- Reduced lighting power by more than 15% (use equation)
- AND 95% high-efficacy lighting in dwelling/sleeping units

C406.2 and C406.3

164

## 2021 Changes to Credit Options: On-site Renewable Energy

### Option 4: Renewable Energy

- Basic renewable credit
  - Total minimum rating of the on-site renewable energy systems:
    - At least 0.86 Btu/h per square foot or 0.25 watts/ft<sup>2</sup> of conditioned floor area
    - At least 2% of the annual energy used for mechanical, SWH, lighting
  - Must exclude recovered or renewable water heating if used for credits
- Enhanced renewable credit
  - Systems that exceed the minimum ratings are eligible for additional energy efficiency credits (use equation)

C406.5

165

## Changes to Credit Options: Reduced Energy Use in SWH

### Option 6: Reduced Energy Use in Service Water Heating

- Applies only to select use groups
  1. Group R-1: Boarding houses, hotels or motels
  2. Group I-2: Hospitals, psychiatric hospitals and nursing homes
  3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas
  4. Group F: Laundries
  5. Group R-2
  6. Group A-3: Health clubs and spas
  7. Group E: Schools with full-service kitchens or locker rooms with showers
  8. Buildings showing a service hot water load of 10% or more of total building energy loads, shown using energy analysis
- Choose one of three options
- **Recovered or renewable water heating.** Building service water-heating system must have one or more of the following sized to provide 30% of the building's annual hot water requirements (70% if required to comply with C403.10.5)
  - Waste heat recovery from service hot water, heat recovery chillers, building equipment or process equipment
  - On-site renewable energy water-heating systems

C406.7

166

## Changes to Credit Options: Reduced Energy Use in SWH

### Option 6: Reduced Energy Use in Service Water Heating

- **Efficient fossil fuel water heater.** The combined input-capacity weighted-average equipment rating of all fossil fuel water-heating equipment in the building must be at least 95 percent Et or 0.95 EF.
  - Buildings required to comply with the high input service water-heating system provision (C4040.2.1) receive only half the credits
- **Heat pump water heater.** Where electric resistance water heaters are allowed, all service hot water system heating requirements must be met using heat pump technology with a combined input-capacity weighted-average EF of 3.0.
  - Air-source heat pump water heaters may not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.7

167

## New Credit Options: Energy Monitoring, FDD, Kitchen Equipment

### Option 9: Energy Monitoring

- Only applies to buildings not otherwise required to have energy monitoring (Section C405.12)

### Option 10: Fault Detection and Diagnostics System

- Only applies to buildings not otherwise required to have energy monitoring (Section C403.2.3)

### Option 11: Efficient Kitchen Equipment

- Only applies to Group A-2 spaces or facilities that include a commercial kitchen with at least one gas or electric fryer
  - Fryers, dishwashers, steam cookers and ovens must meet the efficiency requirements

C406.10, C406.11, C406.12

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# 2021

## Additional Energy Efficiency Credit Requirements

### New buildings

- Must achieve 10 credits from Tables C406.1(1) through C406.1(5)
  - 10 credits = 2.5% cost savings
- Tables based on use group of the building and climate zone
  - Office (Group B)
  - Multifamily (R) & Institutional (I)
  - Schools (E)
  - Retail (M)
  - Other
- Multiple use groups, each use group weighted by floor area to determine weighted average building credit

### Tenant Spaces

- Must achieve 5 credits when selected from these options
  - More efficient HVAC
  - Reduced lighting power
  - Enhanced lighting controls
  - DOAS
  - High-efficiency service water heating
  - Energy monitoring system
- Tenant spaces deemed to comply if entire building uses these credits
  - On-site renewable energy
  - Enhanced envelope
  - Reduced air infiltration

C406.1

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# 2021

## Credits for Group B Occupancies

TABLE C406.1(1)  
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% cooling efficiency improvement	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% cooling efficiency improvement	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced lighting power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enhanced digital lighting controls	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: On-site renewable energy	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: Dedicated outdoor air	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered or renewable water heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Efficient fossil fuel water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat pump water heater	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced envelope performance	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced air infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10: Energy monitoring	4	4	4	4	3	3	3	3	3	3	2	3	2	2	2	2	2
C406.11: Fault detection and diagnostics system	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1

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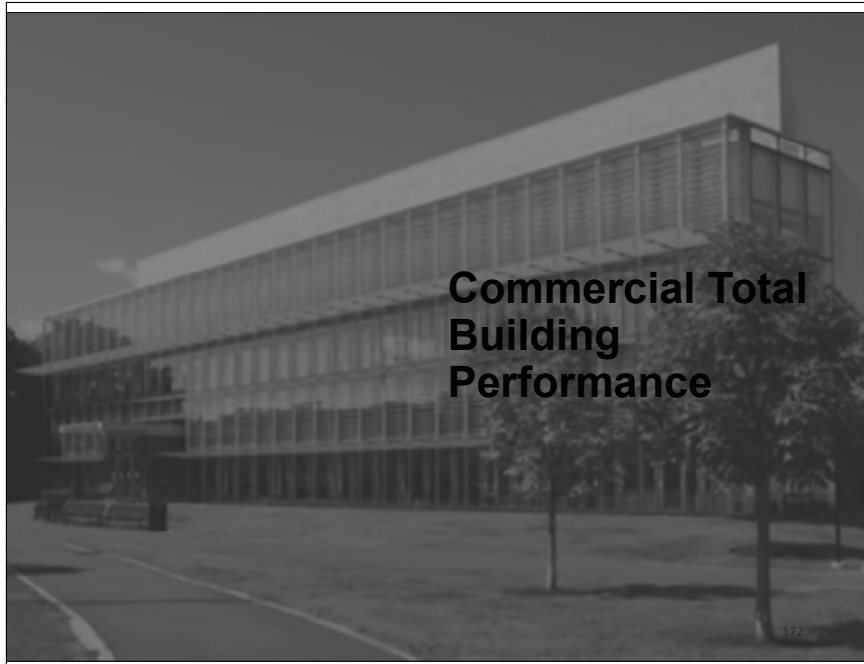
# 2021

## Credits for Group R and I Occupancies

TABLE C406.1(2)  
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

SECTION	CLIMATE ZONE																
	0A & 1A	0B & 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% cooling efficiency improvement	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% heating efficiency improvement	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% cooling efficiency improvement	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3: Reduced lighting power	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
C406.4: Enhanced digital lighting controls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: On-site renewable energy	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: Dedicated outdoor air system	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.2: Recovered or renewable water heating	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Efficient fossil fuel water heater	3	3	0	0	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat pump water heater	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced envelope performance	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Reduced air infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10: Energy monitoring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.11: Fault detection and diagnostics system	1	1	1	1	1	1	NA	1	1	NA	1	1	NA	1	1	1	1

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## Commercial Total Building Performance

2021 

### C407 Total Building Performance

#### 2018 IECC

**C401.2 Application.** Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

**C407.2 Mandatory requirements.** Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.

85%

#### 2021 IECC

**C401.2 Application.** Commercial buildings shall comply with Section C401.2.1 or C401.2.2.

**C401.2.1 International Energy Conservation Code.** Commercial buildings shall comply with one of the following:

1. **Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. **Total Building Performance.** The Total Building Performance option requires compliance with Section C407.

**C407.2 Mandatory requirements.** Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.

80%

2. An annual energy cost that is less than or equal to 80 percent of the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source

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2021 

### C407 Total Building Performance

#### 2018 IECC

**C401.2 Application.** Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

**C407.2 Mandatory requirements.** Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.

#### 2021 IECC

**C401.2 Application.** Commercial buildings shall comply with Section C401.2.1 or C401.2.2.

**C401.2.1 International Energy Conservation Code.** Commercial buildings shall comply with one of the following:

1. **Prescriptive Compliance.** The Prescriptive Compliance option requires compliance with Sections C402 through C406 and Section C408. Dwelling units and sleeping units in Group R-2 buildings without systems serving multiple units shall be deemed to be in compliance with this chapter, provided that they comply with Section R406.
2. **Total Building Performance.** The Total Building Performance option requires compliance with Section C407.

**C407.2 Mandatory requirements.** Compliance based on total building performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.

2. An annual energy cost that is less than or equal to 80 percent of the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source

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# C407.2 Requirements for Total Building Performance

- Must meet requirements of Table C407.2
- Must have an annual energy cost less than or equal to 80 percent of the standard reference design
  - Standard reference design walls to be the same as proposed

SECTION <sup>a</sup>	TITLE
	<b>Envelope</b>
C402.5	Air leakage—thermal envelope
	<b>Mechanical</b>
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4, except C403.4.3, C403.4.4 and C403.4.5	Heating and cooling system controls
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commissioning

a. Reference to a code section includes all the relative subsections except as indicated in the table.



## System Commissioning

- C408.1 General
- C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements
- C408.3 Functional testing of lighting controls



## C408 Maintenance Information and System Commissioning

- Mechanical systems - heating and cooling capacities  $\geq 600,000$  and  $480,000$  Btu/h, respectively
- Service water heating controls
- Lighting systems
  - C408.3.1.1 Occupant sensor controls
  - C408.3.1.2 Time-switch controls
  - C408.3.1.3 Daylight responsive controls
- Preliminary & final commissioning reports
  - Mechanical & service hot water findings in separate sections

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## Existing Buildings

- Clarification that projects complying with ASHRAE 90.1 must comply fully with ASHRAE 90.1
- Pulled in previously referenced Vertical Fenestration and Skylight provisions into the body of the Additions requirements
- Set a backstop for roof insulation for roof replacements under Alterations sections



## Commercial Appendices

**2021** 

### Appendix CA: Board of Appeals

- Appendix CA provides guidance for establishing a board of appeals, including criteria for membership and instruction for developing rules and procedures
- Consistent with other I-Codes



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**2021** 

### Appendix CB: Electrical Energy Storage System-Ready Area

- Appendix CB is intended to encourage the installation of renewable energy systems by preparing buildings for the future installation of solar energy equipment, piping and wiring
- New provision for system-ready area for electrical energy storage
  - 2 x 4 ft area on construction docs



Appendix CB

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# Appendix CC: Zero Energy Commercial Building Provisions

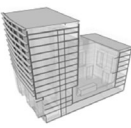
- Appendix CC provides a model for states and jurisdictions to require renewable energy systems capable of achieving net zero carbon
- Applies to new buildings
- Based on Architecture 2030
- Supplemental definitions
  - Adjusted off-site renewable energy
  - Building energy
  - Energy Utilization Intensity (EUI)
  - Off-site renewable energy system
  - On-site renewable energy system
  - Renewable energy system
  - Semiheated space
  - Zero Energy Performance Index (ZEPI PB/EE)

## Zero Energy Commercial Building Provisions

**ZERO CODE**  
Commercial • Institutional • Mid-Rise/High-Rise Residential Buildings for the 2021 IECC  
MEETING THE CODE

**1**

Design an energy efficient building in compliance with the 2021 IECC or better.



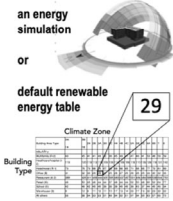
**2**

Establish the building's renewable energy requirement from:

an energy simulation

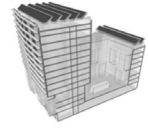
or

default renewable energy table




**3**

Meet the requirement by integrating onsite renewable energy when feasible.



**4**

If necessary, procure offsite renewable energy.



Source: Architecture 2030  
Graphic adaptations: Sefaira; DOE; Green Ideas

## Minimum Renewable Energy

**CC103.1 Renewable energy.** On-site renewable energy systems shall be installed, or off-site renewable energy shall be procured to offset the building energy as calculated in Equation CC-1.

$$RE_{on-site} + RE_{off-site} \geq E_{building} \quad \text{(Equation CC-1)}$$

where:

$RE_{on-site}$  = Annual site energy production from on-site renewable energy systems (see Section CC103.2).

$RE_{off-site}$  = Adjusted annual site energy production from off-site renewable energy systems that may be credited against building energy use (see Section CC103.3).

$E_{building}$  = Building energy use without consideration of renewable energy systems.

- If complying with the Prescriptive Compliance option, building energy is determined:

*gross conditioned floor area + gross semiheated floor area of the proposed building × EUI from Table CC103.1*

- If complying with Total Building Performance or ASHRAE 90.1, building energy is determined from energy simulations

# Energy Utilization Intensity

TABLE CC103.1 Energy Utilization Intensity for Building Types and Climates (kBtu/ft<sup>2</sup> – yr)

Building Area Type	Climate Zone																
	0A/1A	0B/1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
	kBtu/ft <sup>2</sup> -yr																
Healthcare/hospital (I-2)	119	120	119	113	116	109	106	116	109	106	118	110	105	126	116	131	142
Hotel/motel (R-1)	73	76	73	68	70	67	65	69	66	65	71	68	65	77	72	81	89
Multiple-family (R-2)	43	45	41	41	43	42	36	45	43	41	47	46	41	53	48	53	59
Office (B)	31	32	30	29	29	28	25	28	27	25	29	28	25	33	30	32	36
Restaurant (A-2)	380	426	411	408	444	420	305	483	437	457	531	484	484	580	538	644	750
Retail (M)	46	50	45	46	44	44	37	48	44	44	52	50	46	60	52	64	77
School (E)	42	46	42	40	40	39	36	39	40	40	39	43	37	44	40	45	54
Warehouse (S)	9	12	9	11	12	11	10	17	13	14	23	17	15	32	23	32	32
All others	55	58	54	53	53	51	48	54	52	51	57	54	50	63	57	65	73

Table CC103.1

## CC103.3.1 Qualifying Off-Site Procurement Methods

- Community renewables:** an off-site renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.
- Renewable energy investment fund:** an entity that installs renewable energy capacity on behalf of the owner.
- Virtual power purchase agreement:** a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.
- Direct ownership:** an off-site renewable energy system owned by the building project owner.
- Direct access to wholesale market:** an agreement between the owner and a renewable energy developer to purchase renewable energy.
- Green retail tariffs:** a program by the retail electricity provider to provide 100-percent renewable energy to the owner.
- Unbundled Renewable Energy Certificates (RECs):** certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.

## Residential Significant Changes

Chapter 4 and Appendices

## Residential Provisions

- Pertain to detached one- and two-family dwellings and townhouses as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.
- New and existing buildings
- Apply to residential buildings, building sites and associated systems and equipment.



C202



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## Residential Energy Efficiency, Chapter 4

- R401 General
- R402 Building Thermal Envelope
- R403 Systems
- R404 Electrical Power and Lighting Systems
- R405 Total Building Performance
- R406 Energy Rating Index Compliance Alternative
- R407 Tropical Climate Region Compliance Path
- R408 Additional Efficiency Package Options

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## R401.2 Compliance Path Options

- Compliance path options for the residential provisions of the IECC are named and the sections required for each option are outlined
- Tropical Climate Region Option formally recognized as a compliance path

**R401.2 Application.** Residential buildings shall comply with Section R401.2.5 and either Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.

**Exception:** Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

**R401.2.1 Prescriptive Compliance Option.** The Prescriptive Compliance Option requires compliance with Sections R401 through R404.

**R401.2.2 Total Building Performance Option.** The Total Building Performance Option requires compliance with Section R405.

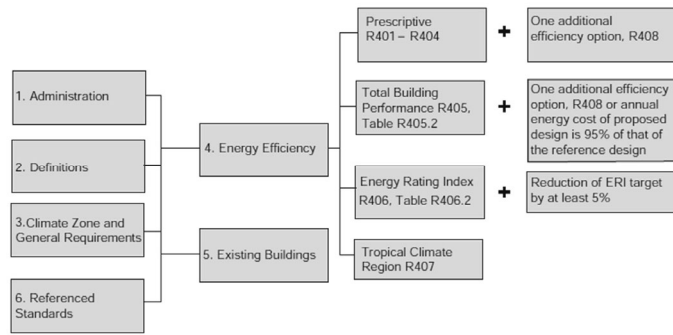
**R401.2.3 Energy Rating Index Option.** The Energy Rating Index (ERI) Option requires compliance with Section R406.

**R401.2.4 Tropical Climate Region Option.** The Tropical Climate Region Option requires compliance with Section R407.

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# Compliance Path Options Continued



R401.2

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## R401.2.5 Additional Energy Efficiency

2021

- Prescriptive Compliance Option
  - Select one additional efficiency package option in Section R408.2
- Total Building Performance option
  - Select one additional efficiency package option in Section R408.2
  - OR
  - Proposed design must have annual energy cost less than or equal to 95% of the referenced design
- Energy Rating Index
  - ERI value must be at least 5% less than ERI target



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## R401.3 Certificate

- Requirements for the certificate are expanded to include
  - Code edition
  - Compliance path
  - Additional energy efficiency option
  - PV system information
  - Energy Rating Index score

Energy Efficiency Certificate			
Code edition	<input type="text"/>		
Compliance path	<input type="text"/>		
Insulation Rating		R-Value	R-Value
Ceiling/Roof		R: <input type="text"/>	R: <input type="text"/>
Walls	Frame	R: <input type="text"/>	Mass
	Basement	R: <input type="text"/>	Crawl space
Floors	Over unconditioned space	R: <input type="text"/>	Slab edges
	Ducts	Attic	R: <input type="text"/>
Air Leakage Test Results			
Envelope testing	<input type="text"/> ACH	<input type="text"/> Pa	Duct testing <input type="text"/> cfm/100 ft <sup>2</sup>
Fenestration Rating		NFRC U-Factor	NFRC SHGC
Window	U: <input type="text"/>	<input type="text"/>	<input type="text"/>
Opaque door	U: <input type="text"/>	<input type="text"/>	<input type="text"/>
Skylight	U: <input type="text"/>	<input type="text"/>	<input type="text"/>
Weighted average	U: <input type="text"/>	<input type="text"/>	<input type="text"/>
Equipment Performance		Type	Efficiency
Heating system	<input type="text"/>	<input type="text"/>	AFUE <input type="text"/>
Cooling system	<input type="text"/>	<input type="text"/>	SEER <input type="text"/>
Water heater	<input type="text"/>	<input type="text"/>	EF <input type="text"/>
Indicate if the following have been installed (an efficiency shall not be listed)			
<input type="checkbox"/> electric furnace <input type="checkbox"/> gas-fire unvented room heater <input type="checkbox"/> baseboard electric heater			
Additional Energy Efficiency (check one)			
<input type="checkbox"/> Proposed design had an annual energy cost ≤ 95% of that of the reference design			
<input type="checkbox"/> Energy Rating Index score is at least 5% less than ERI target			
<input type="checkbox"/> Additional efficiency package option is installed (specify option) <input type="text"/>			
Photovoltaic Panel System		Energy Rating Index Score	
Array capacity	<input type="text"/>	with PV	<input type="text"/>
Inverter efficiency	<input type="text"/>	without PV	<input type="text"/>
Panel tilt	<input type="text"/>		
Orientation	<input type="text"/>		
Designer/builder	<input type="text"/>	Date	<input type="text"/>
This Certificate is to be posted in accordance with Section R401.3 of the International Energy Conservation Code.			



# Residential Building Envelope

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## Key Building Envelope Provisions

- Insulation and fenestration values
- Eave baffles
- Steel frame wall values
- Sunrooms
- Air leakage controls
- Some buildings exempt from envelope provisions
  - Low-energy buildings
    - Peak design rate less than 3.4 Btu/h × ft<sup>2</sup>
    - Buildings with no conditioned space
  - Log homes

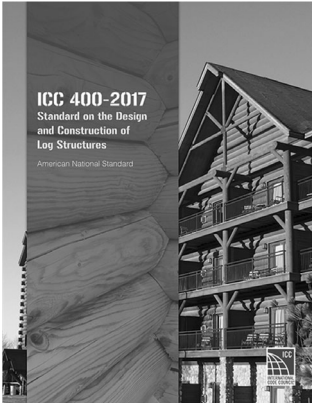
R402

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**2018** 

## R402.1 General

- Added exception to the thermal envelope requirements for log homes designed in accordance with ICC 400



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# Insulation and Fenestration Criteria

- The assembly U-Factor is established as the primary insulation metric, and R-Value is an alternative.

## 2018 IECC

**R402.1.2 Insulation and fenestration criteria.** The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the *climate zone* specified in Chapter 3.

**R402.1.4 U-factor alternative.** An assembly with a *U-factor* equal to or less than that specified in Table R402.1.4 shall be an alternative to the *R-value* in Table R402.1.2.

## 2021 IECC

**R402.1.2 Insulation and fenestration criteria.** The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the *climate zone* specified in Chapter 3. Assemblies shall have a *U-factor* equal to or less than that specified in Table R402.1.2. Fenestration shall have a *U-factor* and glazed fenestration SHGC equal to or less than that specified in Table R402.1.2.

**R402.1.3 R-value alternative.** Assemblies with *R-value* of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the *U-factor* in Table R402.1.2.

R402.1.2 and R402.1.3

TABLE R402.1-4 R402.1.2 Equivalent Maximum Assembly U-Factors<sup>a</sup> and Fenestration Requirements

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>1</sup>	SKYLIGHT U-FACTOR <sup>2</sup>	GLAZED FENESTRATION SHGC <sup>3a</sup>	CEILING U-FACTOR	WOOD FRAME WALL U-FACTOR	MASS WALL U-FACTOR <sup>b</sup>	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
0	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
1	0.50	0.75	0.25	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.25	0.030	0.084	0.165	0.064	0.360	0.477
3	0.30	0.55	0.25	0.026	0.060	0.098	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.30	0.55	0.40	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	NR	0.026	0.045	0.082	0.033	0.050	0.055
6	0.30	0.55	NR	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	NR	0.026	0.045	0.057	0.028	0.050	0.055

For SI: 1 foot = 304.8 mm.

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall U-factors shall not exceed 0.17 in Climate Zones 0 and 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In Warm Humid locations as defined by Figure R301.1 and Table R301.1, the basement wall U-factor shall not exceed 0.360.

d. The SHGC column applies to all glazed fenestration.

**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

e. There are no SHGC requirements in the Marine Zone.

f. A maximum U-factor of 0.32 shall apply in Marine Climate Zone 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located either:

- Above 4,000 feet in elevation above sea level, or
- In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

Table R402.1.2

TABLE R402.1-2 TABLE R402.1.3 Insulation Minimum R-values and Fenestration Requirements By Component<sup>a</sup>

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>1a</sup>	SKYLIGHT U-FACTOR <sup>2</sup>	GLAZED FENESTRATION SHGC <sup>3a</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE <sup>b</sup>	MASS WALL R-VALUE <sup>b</sup>	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB <sup>4</sup> R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
0	NR	0.75	0.25	30	13 or 0 & 10ci <sup>5</sup>	3/4	13	0	0	0
1	NR	0.75	0.25	30	13 or 0 & 10ci <sup>5</sup>	3/4	13	0	0	0
2	0.40	0.65	0.25	0.40	13 or 0 & 10ci <sup>5</sup>	4/6	13	0	0	0
3	0.30	0.55	0.25	0.40	20 or 13 & 5ci <sup>5</sup> or 0 & 15ci <sup>5b</sup>	8/13	19	5/19 <sup>6</sup> 5ci or 13 <sup>7</sup>	010ci, 2 ft	5/19 5ci or 13 <sup>7</sup>
4 except Marine	0.30	0.55	0.40	0.40	30 or 20 & 5ci <sup>5</sup> or 13 & 10ci <sup>5</sup> or 0 & 20ci <sup>5</sup>	8/13	19	10ci, 4 ft	10ci, 4 ft	10ci, 4 ft
5 and Marine 4	0.30 <sup>1</sup>	0.55	NR	0.40	30 or 20 & 5ci <sup>5</sup> or 13 & 10ci <sup>5</sup> or 0 & 20ci <sup>5</sup>	13/17	30 <sup>8</sup>	15/19 15ci or 19 or 13 & 5ci	10ci, 4 ft	15/19 15ci or 19 or 13 & 5ci
6	0.30 <sup>1</sup>	0.55	NR	0.40	30 or 20 & 5ci <sup>5</sup> or 13 & 10ci <sup>5</sup> or 0 & 20ci <sup>5</sup>	15/20	30 <sup>8</sup>	15/19 15ci or 19 or 13 & 5ci	10ci, 4 ft	15/19 15ci or 19 or 13 & 5ci
7 and 8	0.30 <sup>1</sup>	0.55	NR	0.40	30 or 20 & 5ci <sup>5</sup> or 13 & 10ci <sup>5</sup> or 0 & 20ci <sup>5</sup>	19/21	38 <sup>8</sup>	15/19 15ci or 19 or 13 & 5ci	10ci, 4 ft	15/19 15ci or 19 or 13 & 5ci

For SI: 1 foot = 304.8 mm.

NR = Not Required.

ci = continuous insulation.

Table R402.1.3

## Climate Zone 3 – Insulation R-Values

IECC Edition	Ceiling	Wood Frame Wall	Mass Wall	Floor	Basement Wall	Slab & Depth	Crawl Space Wall
2009	30	13	5/8	19	5/13	0	5/13
2012	38	20 or 13+5	8/13	19	5/13	0	5/13
2015	38	20 or 13+5	8/13	19	5/13	0	5/13
2018	38	20 or 13+5	8/13	19	5/13	0	5/13
2021	49	20 or 13 & 5ci or 0 & 15ci	8/13	19	5ci or 13	10ci, 2ft	5ci or 13

## Climate Zone 4A and 4B – Insulation R-Values

IECC Edition	Ceiling	Wood Frame Wall	Mass Wall	Floor	Basement Wall	Slab & Depth	Crawl Space Wall
2009	38	13	5/10	19	10/13	10, 2ft	10/13
2012	49	20 or 13+5	8/13	19	10/13	10, 2ft	10/13
2015	49	20 or 13+5	8/13	19	10/13	10, 2ft	10/13
2018	49	20 or 13+5	8/13	19	10/13	10, 2ft	10/13
2021	60	30 or 20 & 5ci or 13 & 10ci or 0 & 20ci	8/13	19	10ci or 13	10ci, 4ft	10ci or 13 <sup>203</sup>

## Climate Zone 5 and 4C– Insulation R-Values

IECC Edition	Ceiling	Wood Frame Wall	Mass Wall	Floor	Basement Wall	Slab & Depth	Crawl Space Wall
2009	38	20 or 13+5	13/17	30	10/13	10, 2ft	10/13
2012	49	20 or 13+5	13/17	30	15/19	10, 2ft	15/19
2015	49	20 or 13+5	13/17	30	15/19	10, 2ft	15/19
2018	49	20 or 13+5	13/17	30	15/19	10, 2ft	15/19
2021	60	30 or 20 & 5ci or 13 & 10ci or 0 & 20ci	13/17	30	15ci or 19 or 13 & 5ci	10ci, 4ft	15ci or 19 or 13 & 5ci <sup>204</sup>

## Climate Zone 6 – Insulation R-Values

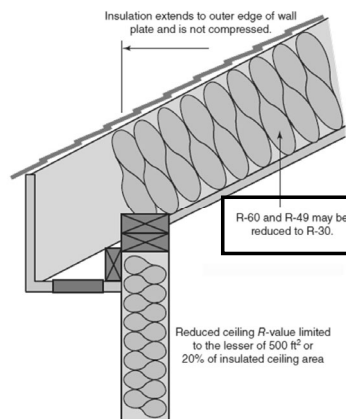
IECC Edition	Ceiling	Wood Frame Wall	Mass Wall	Floor	Basement Wall	Slab & Depth	Crawl Space Wall
2009	49	20 or 13+5	15/19	30	15/19	10, 4ft	10/13
2012	49	20+5 or 13+10	15/20	30	15/19	10, 4ft	15/19
2015	49	20+5 or 13+10	15/20	30	15/19	10, 4ft	15/19
2018	49	20+5 or 13+10	15/20	30	15/19	10, 4ft	15/19
2021	60	30 or 20 & 5ci or 13 & 10ci or 0 & 20ci	15/20	30	15ci or 19 or 13 & 5ci	10ci, 4ft	15ci or 19 or 13 & 5ci

## Climate Zone 7 & 8 – Insulation R-Values

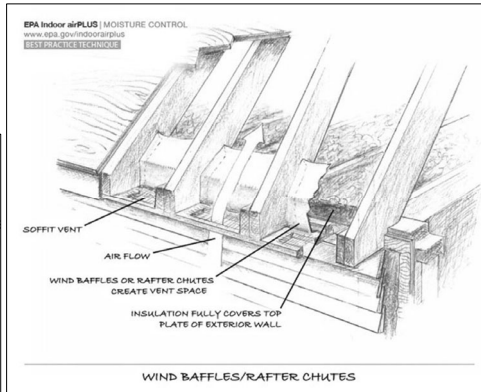
IECC Edition	Ceiling	Wood Frame Wall	Mass Wall	Floor	Basement Wall	Slab & Depth	Crawl Space Wall
2009	49	21	19/21	38	15/19	10, 4ft	10/13
2012	49	20+5 or 13+10	19/21	38	15/19	10, 4ft	15/19
2015	49	20+5 or 13+10	19/21	38	15/19	10, 4ft	15/19
2018	49	20+5 or 13+10	19/21	38	15/19	10, 4ft	15/19
2021	60	30 or 20 & 5ci or 13 & 10ci or 0 & 20ci	19/21	38	15ci or 19 or 13 & 5ci	10ci, 4ft	15ci or 19 or 13 & 5ci

## R402.2.1 and R402.2.2 Ceiling Insulation 2021

- Options for reduction in R-values for ceilings with and without attics adjusted to recognize increase in ceiling R-values



## R402.2.3 Eave Baffle



- For air-permeable insulation in vented attics, a baffle must be installed adjacent to soffit and eave vents
- Permitted to be any solid material
- Must be installed to the outer edge of the exterior wall top plate

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## R402.2.4 Access Hatches and Doors

2021

From conditioned to unconditioned spaces

- Attics, crawl spaces
- Insulated to the same R-value for surround wall or ceiling surrounding
- Weatherstripped
- Blocked for loose fill
- Access provided to all equipment without damaging or compressing insulation



Building America Solution Center

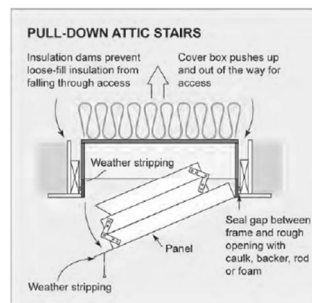
209

## Access Hatches or Doors Exception

2021

- Drop-down stairs (horizontal pull-down) in Climate Zones 0-4 not required to meet the surrounding insulation level if all of the following are met
  - Hatch has a U-factor of 0.10 or less, or average R-Value of R-10 or greater
  - At least 75% of panel area has R-13 or greater insulation
  - Opening is less than 13.5ft<sup>2</sup>
  - Perimeter is weather-stripped

Does not apply to the total UA alternative in Section R402.1.5



EnergySavers

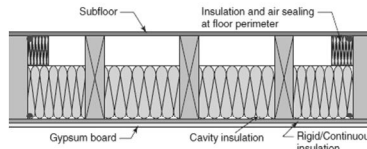
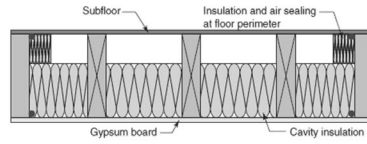
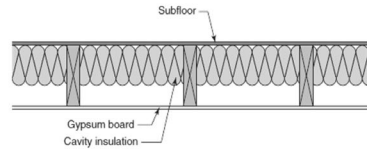
R402.2.4

210

## R402.2.7 Floor Insulation

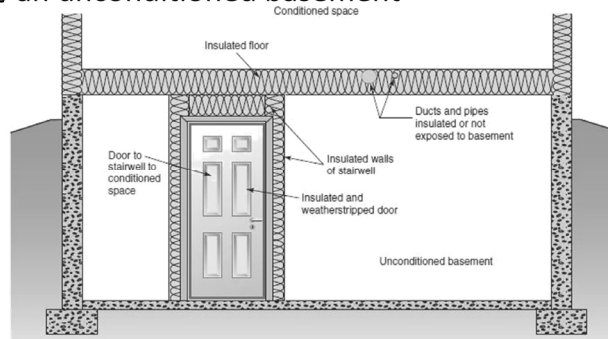
- Three compliance methods

- Cavity insulation underside of subfloor
- Cavity insulation top side of ceiling
- Cavity and continuous insulation top side of ceiling



## R402.2.8 Unconditioned Basement

- Specific criteria must be met for a space to qualify as an unconditioned basement



## R402.2.8 Basement Walls

Exceptions to the basement walls provision clearly define the characteristics of unconditioned basements

- The floor overhead, including the underside stairway stringer leading to the basement, is insulated
- There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement
- There are no HVAC supply or return diffusers serving the basement
- The walls surrounding the stairway and adjacent to conditioned space are insulated
- The door(s) leading to the basement from conditioned spaces are insulated and weatherstripped
- The building thermal envelope separates the basement from adjacent conditioned spaces



## Climate Zone 3 – Fenestration

IECC Edition	U-Factor	Skylight U-Factor	SHGC	Air Leakage
2009	0.50	0.65	0.30	0.3 cfm/ft <sup>2</sup>
2012	0.35	0.55	0.25	0.3 cfm/ft <sup>2</sup>
2015	0.35	0.55	0.25	0.3 cfm/ft <sup>2</sup>
2018	0.32	0.55	0.25	0.3 cfm/ft <sup>2</sup>
2021	0.30	0.55	0.25	0.3 cfm/ft <sup>2</sup>

Windows, skylights, sliding glass doors

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## Climate Zone 4A and 4B – Fenestration

IECC Edition	U-Value	Skylight U-Value	SHGC	Air Leakage
2009	0.35	0.60	NR	0.3 cfm/ft <sup>2</sup>
2012	0.35	0.55	0.40	0.3 cfm/ft <sup>2</sup>
2015	0.35	0.55	0.40	0.3 cfm/ft <sup>2</sup>
2018	0.32	0.55	0.40	0.3 cfm/ft <sup>2</sup>
2021	0.30	0.55	0.40	0.3 cfm/ft <sup>2</sup>

Windows, skylights, sliding glass doors

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## Climate Zone 5 and 4C – Fenestration

IECC Edition	U-Value	Skylight U-Value	SHGC	Air Leakage
2009	0.35	0.60	NR	0.3 cfm/ft <sup>2</sup>
2012	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2015	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2018	0.30	0.55	NR	0.3 cfm/ft <sup>2</sup>
2021	0.30	0.55	0.40	0.3 cfm/ft <sup>2</sup>

Windows, skylights, sliding glass doors

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## Climate Zone 6 – Fenestration

IECC Edition	U-Value	Skylight U-Value	SHGC	Air Leakage
2009	0.35	0.60	NR	0.3 cfm/ft <sup>2</sup>
2012	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2015	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2018	0.30	0.55	NR	0.3 cfm/ft <sup>2</sup>
2021	0.30	0.55	NR	0.3 cfm/ft <sup>2</sup>

Windows, skylights, sliding glass doors

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## Climate Zone 7 & 8 – Fenestration

IECC Edition	U-Value	Skylight U-Value	SHGC	Air Leakage
2009	0.35	0.60	NR	0.3 cfm/ft <sup>2</sup>
2012	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2015	0.32	0.55	NR	0.3 cfm/ft <sup>2</sup>
2018	0.30	0.55	NR	0.3 cfm/ft <sup>2</sup>
2021	0.30	0.55	NR	0.3 cfm/ft <sup>2</sup>

Windows, skylights, sliding glass doors

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## R402.2.12 and R402.3.5 Sunroom and Heated Garage Insulation and Fenestration **2021**

Applies to thermally isolated sunrooms and heated garages with enclosed conditioned space

Ceiling	Walls	Windows	Skylights
<ul style="list-style-type: none"> <li>• CZ 0 – 4: R-19</li> <li>• CZ 5 – 8: R-24</li> </ul>	<ul style="list-style-type: none"> <li>• R-13</li> <li>• Walls separating sunroom/garage from conditioned space, follow code</li> </ul>	<ul style="list-style-type: none"> <li>• CZ 2 – 8: U-0.45</li> </ul>	<ul style="list-style-type: none"> <li>• CZ 2 – 8: 0.70</li> </ul>
R-60	R-30	U-0.30	U-0.55

Compare to CZ6

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## Table R402.4.1.1 Plumbing, Wiring or Other Obstructions

- All holes created by wiring, plumbing or other obstructions in the air barrier assembly must be air sealed
- Insulation must be installed to fill the available space
  - Unless required R-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions
  - FILL does not mean COMPRESS

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### Plumbing, Wiring or Other Obstructions: Example

Compliant

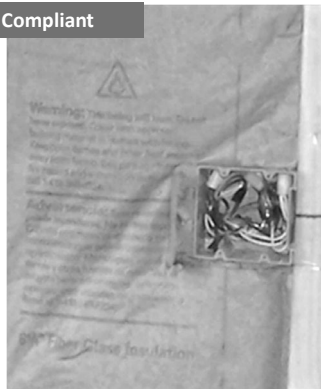


Table R402.4.1.1

Not Compliant



Newport Ventures

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### Plumbing, Wiring or Other Obstructions: Example



Not Compliant

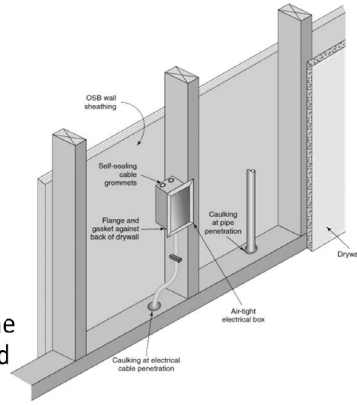
Newport Ventures

Table R402.4.1.1

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## R402.4.6 Air-Sealed Electrical Boxes

- Electrical and communication outlet boxes installed in the building thermal envelope
  - Sealed
  - Tested NEMA OS 4
  - Marked "NEMA OS 4" or "OS 4"
  - Installed per manufacturer's instructions and NEMA OS 4
- Only applicable when used as the alternative to air barrier installed behind boxes



## R402.4.1.2 Air leakage



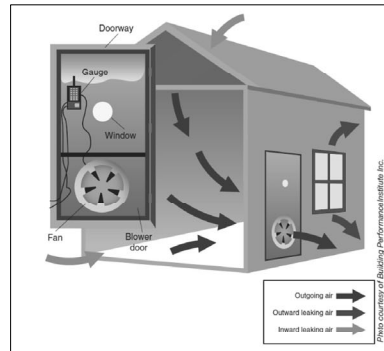
- Air leakage requirements are revised
  - 5 ACH for all compliance paths
  - 3 ACH for CZ 3 – 8 complying prescriptively
- New definition for dwelling unit enclosure area

**2021 CODE: DWELLING UNIT ENCLOSURE AREA.** *The sum of the area of ceiling, floors and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.*

IECC Edition	Climate Zones	Checklist (Table R402.1.4)	Blower Door Test	Target for all Compliance Paths	Prescriptive Target
2009	1 – 8	Optional (or Test)	Optional (or Checklist)	7 ACH50 (If Testing)	N/A
2012	1 and 2	Mandatory	Mandatory	5 ACH50	N/A
	3 – 8			3 ACH50	
2015	1 and 2	Mandatory	Mandatory	5 ACH50	N/A
	3 – 8			3 ACH50	
2018	1 and 2	Mandatory	Mandatory	5 ACH50	N/A
	3 – 8			3 ACH50	
2021	0 – 2	Mandatory	Mandatory	5 ACH50	5 ACH50
	3 – 8			5 ACH50	3 ACH50

## Air Leakage Testing Continued

- Testing conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827
- Testing performed at any time after creation of all penetrations of the building thermal envelope have been sealed



R402.4.1.2

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## Air Leakage Testing Continued

- Exception for heated attached and detached private garages that are thermally isolated from all other habitable, conditioned spaces

TABLE R402.4.1.1  
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION\*

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, <i>R</i> -value, of not less than <i>R</i> -3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.

R402.4.1.2

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## Air Leakage Testing Continued

- Additional exception for testing individual dwelling units
- Air leakage rate of 0.3 cfm/ft<sup>2</sup> at 50 Pa permitted in all climate zones for
  - Attached single and multi-family dwelling units
  - Detached dwelling units that are 1,500 ft<sup>2</sup> or smaller

R402.4.1.2

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## R402.5 Maximum Fenestration and U-factor and SHGC

- The maximum fenestration *U*-factors are reduced
  - Vertical fenestration *U*-factor
    - 0.48 in Climate Zones 4 and 5
    - 0.40 in Climate Zones 6 through 8
  - Skylights *U*-factor
    - 0.75 in Climate Zones 4 through 8
  - SHGC
    - 0.40 in Climate Zones 0 through 3
- Exception provided for storm shelters
  - Complying with ICC 500



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## Key Building Systems Provisions

- Mechanical equipment efficiency
- Water heater efficiency
- Programmable thermostat
- Heat pump supplementary heat
- Ducts
- Insulation
- Ventilation - IMC



## R403.3.1 – R403.3.3.1 Ducts

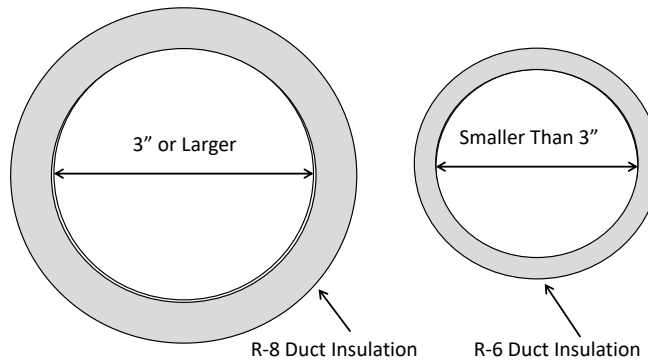
- Duct locations and the insulation requirements for each clarified
  - Outside conditioned space
  - In conditioned space
  - Buried



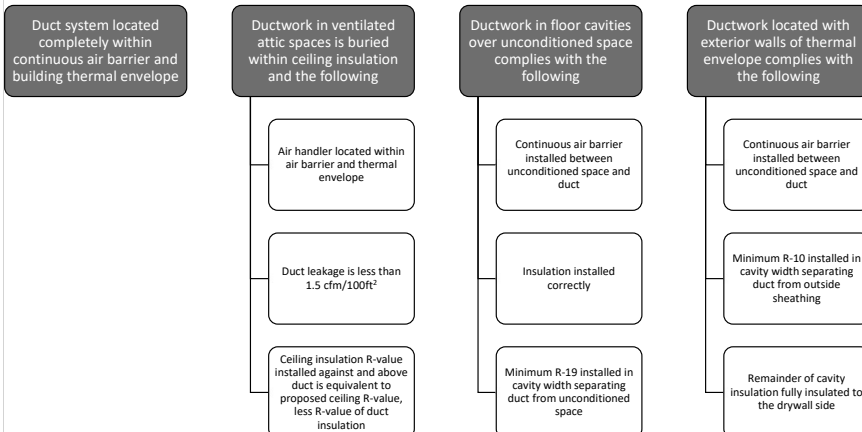
## R403.3.1 Duct Location and Insulation: Outside Conditioned Space

Ducts located outside conditioned space

- Minimum R-8 for ducts over 3" diameter. Minimum R-6 for ducts under 3" diameter
- Buried ducts insulated per section or have an equivalent thermal distribution efficiency, listed and labeled



## R403.3.2 Duct Location and Insulation: Inside Conditioned Space



## Ducts in Conditioned Space: Examples



R403.3.2



Newport Ventures

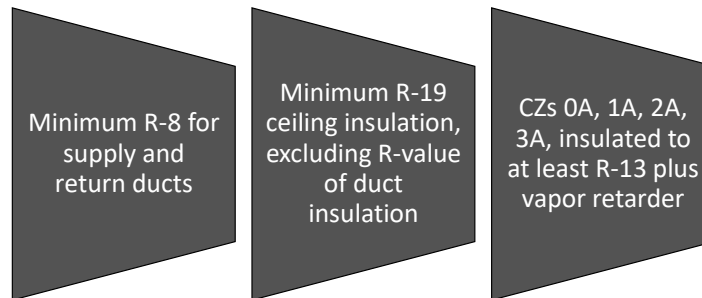


Newport Ventures

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**2021**

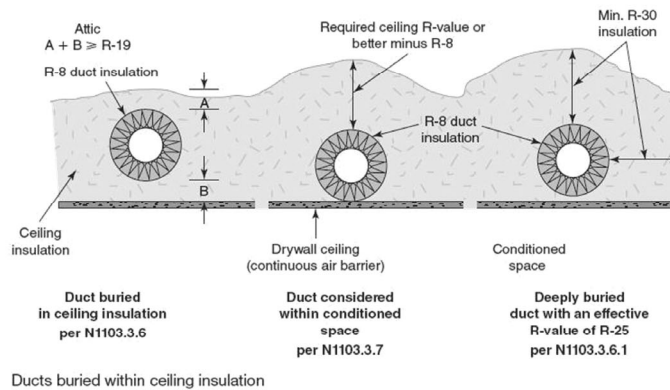
### R403.3.3 Duct Location and Insulation: Buried Within Ceiling Insulation



R403.3.3

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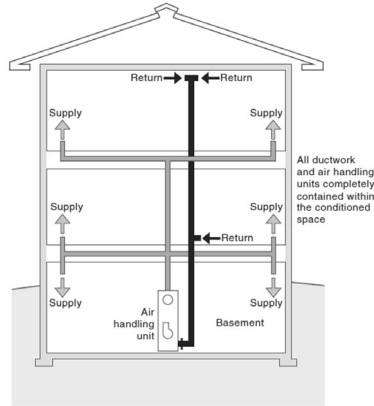
### Duct Location and Insulation: Buried Within Ceiling Insulation



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## R403.3.5 Duct Testing

- Testing in accordance with ANSI/RESNET/ICC 380 or ASTM E1554
  - Rough-in test
  - Postconstruction test
- Testing not required for ducts serving ventilation systems that are not integrated with ducts serving heating or cooling systems



## Duct Testing Continued

- Exception for duct testing of ducts in conditioned spaces is deleted



R403.3.5



## R403.3.6 Duct Leakage

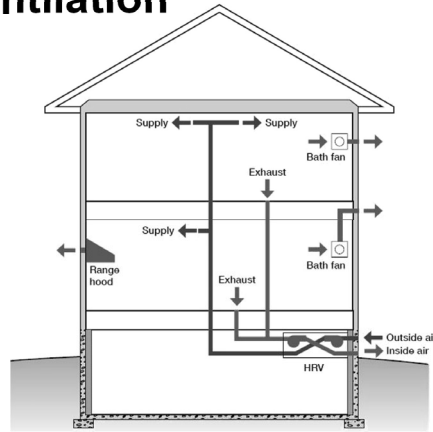
Rough-in Test	Postconstruction	Test for ducts within thermal envelope
<ul style="list-style-type: none"> <li>• 4.0 cfm/100ft<sup>2</sup> of conditioned floor area where the air handler is installed at the time of the test</li> <li>• 3.0 cfm/100ft<sup>2</sup> where air handler not installed</li> </ul>	<ul style="list-style-type: none"> <li>• 4.0 cfm/100ft<sup>2</sup> of conditioned floor area</li> </ul>	<ul style="list-style-type: none"> <li>• 8.0 cfm/100ft<sup>2</sup> of conditioned floor area</li> <li>• All ducts and air handlers entirely within building thermal envelope</li> </ul>

R403.3.6



## R403.6.2 Mechanical Ventilation

2018   
2021 



- HRV or ERV system is required in climate zones 7 and 8
- Mechanical ventilation systems now require testing

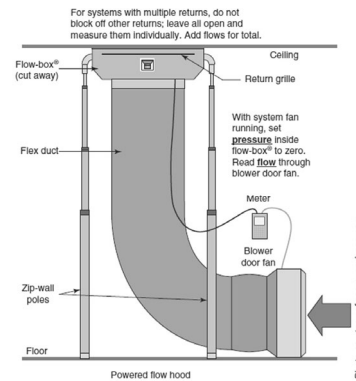
R403.6.2

241

## R403.6.3 Testing

2021 

- Each dwelling is required to have a minimum mechanical ventilation rate per IRC Section M1505
- New provisions for testing not only the whole-house ventilation referenced in the IRC, but also spot ventilation such as bathroom fans
- Kitchen range hoods with ducts 6 inches or larger in diameter are exempt from the requirement




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## R404.1 Lighting Equipment

2018   
2021 


- High-efficacy lighting is now required in all permanent lighting fixtures
- New provisions regulate lighting controls for interior and exterior lighting



R404.1

244

## R404.1.1 Exterior Lighting

2021 

- Connected exterior lighting must comply with the commercial requirements for exterior lighting power, C405.5



### Exceptions:

1. Detached one- and two-family dwellings.
2. Townhouses.
3. Solar-powered lamps not connected to any electrical service.
4. Luminaires controlled by a motion sensor.
5. Lamps and luminaires that comply with Section R404.1.

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## R404.2 Interior Lighting Controls

2021 

- Permanently installed lighting fixtures are required to have either a dimmer, occupant sensor or other control unless exempt
- Exceptions
  - Bathrooms
  - Hallways
  - Exterior lighting fixtures
  - Lighting designed for safety or security



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# R404.3 Exterior Lighting Controls



Total permanently installed exterior lighting power greater than 30 watts

- Manual on/off switch
  - Exception: lighting serving multiple dwelling units
- Daylight sensor
- Overrides must reset after 24 hours



## Residential Total Building Performance

# R405.2 Total Building Performance

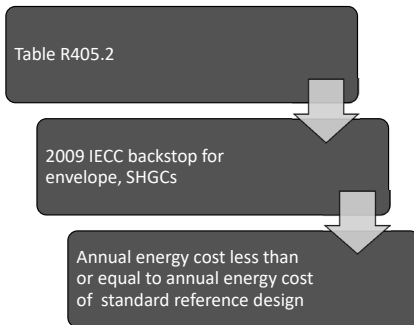


TABLE R405.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE	
SECTION*	TITLE
General	
R401.2.5	Additional energy efficiency
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Crawl space wall insulation installations
R402.4.1.1	Installation
R402.4.1.2	Testing
R402.5	Maximum fenestration U-factor and SHGC
Mechanical	
R403.1	Controls
R403.3, including R403.3.1, except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water circulation and temperature maintenance systems
R403.5.3	Drain water heat recovery units
R403.6	Mechanical ventilation
R403.7	Equipment sizing and efficiency rating
R403.8	Systems serving multiple dwelling units
R403.9	Snow melt and ice systems
R403.10	Energy consumption of pools and spas
R403.11	Portable spas
R403.12	Residential pools and permanent residential spas
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls

\* Reference to a code section includes all the relative subsections except as indicated in the table.

# R405.3.2 Compliance Report

Compliance report is simplified for greater usability and easier enforcement

1. Building street address or other site identification
2. Declaration of the total building performance path on the title page of the energy report and the title page of the building plans
3. A statement, bearing the name of the individual performing the analysis and generating the report, indicating that the as-built building complies with Section R405.3.
4. The name and version of the compliance software tool.
5. A site-specific energy analysis report that is in compliance with Section R405.3.
6. A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home, including component-level insulation R-values or U-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation and service water-heating equipment installed.
7. When on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

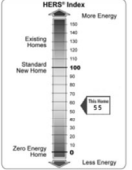


## Energy Rating Index Overview

- ERI compliance requires the design to be a specified percentage better than the referenced home.
- Rated Home with Index of 100 = Reference Home meeting 2006 IECC
- Each 1% reduction in energy use = 1 point deduction from index
- Zero Energy Home = ERI Index of 0
- Essentially a HERS score with modified ventilation rate

### 2015 IECC ENERGY RATING INDEX REPORT

Property: IL Organization: HERS Confirmed Rating



Annual Energy Consumption			
	HERS Reference Home (kBtu/yr)	Rated Home (kBtu/yr)	Rated Home Cost (\$/yr)
Heating	16.9	32.9	771
Cooling	23.1	4.7	44
Water Heating	12.8	8.0	197
Lights & Appliances	32.4	28.1	773
Photovoltaics	0	-0.0	-0
<b>Total</b>	<b>85.2</b>	<b>73.7</b>	<b>1985</b>

**Annual Estimates**

Electric (kWh): 5046 CO2 Emissions(Tons): 12  
 Natural Gas(Therms): 731 Energy Savings (\$/yr): 1779  
\*Based on standard operating conditions  
 \*\*Based on U.S. DOE designation of a HERS index of 100 as the "Typical Existing Home"

**TARGET INDEX: 55      HERS INDEX: 55      PASS**

This home MEETS the RESNET home energy rating index requirements of Sections 406.3 and 406.4 of the 2015 International Energy Conservation Code based on a climate zone of 5A.

Name: \_\_\_\_\_ Signature: \_\_\_\_\_  
 Organization: \_\_\_\_\_ Date: 12 January 2016

**Mandatory Requirements**

HERS Target	PASS	Duct Insulation (Ducts outside R-6, Inside is R-0)	PASS
2009 IECC-USA	PASS	Maximum Penetration U-Factor (2012)	PASS
Duct Sealing (2012)	PASS	Maximum Penetration SMC (2012)	PASS
Mechanical Ventilation	PASS	Air Leakage (15 ACH50 for C1-2, 3 ACH50 for C3-8)	PASS
Mechanical Ventilation Efficiency	PASS		

# ERI Compliance

## 1. Table R406.2

SECTION	TITLE
General	
R401.2.5	Additional efficiency packages
R401.3	Certificate
Building Thermal Envelope	
R402.1.1	Vapor retarder
R402.2.3	Eave baffle
R402.2.4.1	Access hatches and doors
R402.2.10.1	Craft space wall insulation installation
R402.4.1.1	Installation
R402.4.1.2	Testing
Mechanical	
R403.1	Controls
R403.3 except Sections R403.3.2, R403.3.3 and R403.3.6	Ducts
R403.4	Mechanical system piping insulation
R403.5.1	Heated water calculation and
R403.5.3	
R403.6	
R403.7	
R403.8	
R403.9	
R403.10	
R403.11	
R403.12	
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
404.2	Interior lighting controls
R406.3	Building thermal envelope

a. Reference to a code section includes all of the relative subsections except as indicated in the table.

R406.3 introduces provisions for buildings with and without on-site renewables

- Without on-site renewables
  - Proposed total UA ≤ prescriptive UA × 1.15
- With on-site renewables
  - Back stop of 2018 IECC
  - Credit for renewables limited to 5% of the total home energy use

R406.2

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# Table R406.5 ERI-Based Compliance

CLIMATE ZONE	ENERGY RATING INDEX <sup>a</sup>
0-1	57 <u>52</u>
2	57 <u>52</u>
3	57 <u>51</u>
4	62 <u>54</u>
5	64 <u>55</u>
6	64 <u>54</u>
7	58 <u>53</u>
8	58 <u>53</u>

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# R406.7.3 Renewable Energy Certificate Documentation

Where on-site renewable energy is included in ERI, either:

- Substantiation that the RECs are owned by, or retired on behalf of, the homeowner
- Contract that conveys to the homeowner the RECs associated with the renewable energy



**RENEWABLE ENERGY CERTIFICATE (REC).** An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).

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## R407 Tropical Climate Region Compliance Path **2021**

- Alternative criteria for residential buildings in the tropical region at elevations less than 2,400 feet above sea level
- Provisions moved to Section R407
- No changes to technical requirements

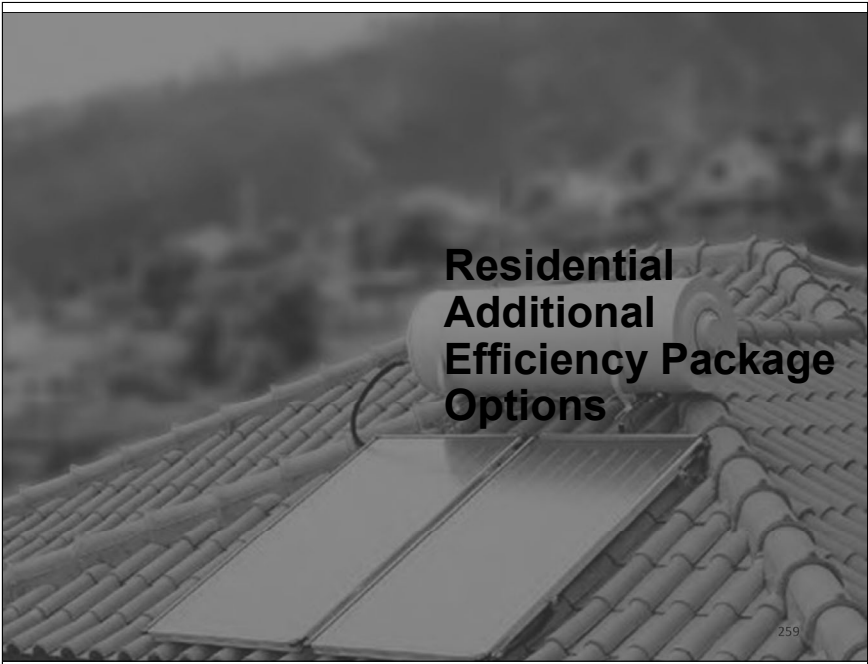


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## C407.2 Compliance Criteria

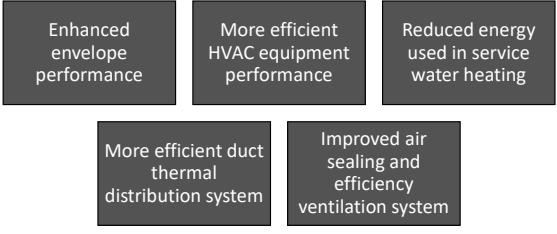
1. Not more than one-half of the occupied space is air conditioned.
2. The occupied space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 % of the energy for SWH
4. Glazing in conditioned spaces has SHGC of 0.40 or less, or has an overhang with a projection factor of at least 0.30.
5. Permanently installed lighting complies with Section R404.
6. The exterior roof surface complies with one of the options in Table C402.3 or the roof or ceiling has insulation with an R-value of at least R-15. Attics above the insulation are vented and attics below the insulation are unvented.
7. Roof surfaces have a slope of not less than 1/4 unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of at least 14% of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

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## R408 Additional Efficiency Package Options **2021**

- Choice of additional efficiency measure required for Prescriptive compliance option and Total Building Performance



## Option 1: Enhanced Envelope Performance **2021**

- Total building thermal envelope UA (the sum of U-factor times assembly area) must be less than or equal to 95% of the total UA resulting from multiplying the U-factors in Table R402.1.2 by the same assembly area as in the proposed building
  - Calculation performed in accordance with Section R402.1.5
- The area-weighted average SHGC of all glazed fenestration must be less than or equal to 95% of the maximum glazed fenestration SHGC in Table R402.1.2

**2021** 

## Option 2: More Efficient HVAC Equipment Performance

Heating and cooling equipment must meet one of the following:

1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.
2. Greater than or equal to 10 HSPF/16 SEER air source heat pump.
3. Greater than or equal to 3.5 COP ground source heat pump.

### Multiple systems

- All systems must meet or exceed efficiency requirements of this section and be sized to serve 100% of the cooling or heating design load

R408.2.2

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**2021** 

## Option 3: Reduced Energy Use in Service Water Heating

Hot water system must meet one of the following:

1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.0 EF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.

R408.2.3

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**2021** 

## Option 4: More Efficient Duct Thermal Distribution System

Duct system must meet one of the following:

1. All ducts and air handlers located entirely within the building thermal envelope
2. Entire ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope
3. 100 percent of duct thermal distribution system located in conditioned space

R408.2.4

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## Option 5: Improved Air Sealing and Efficient Ventilation System

- Measured air leakage rate must be less than or equal to 3.0 ACH50
- Must have either an Energy Recovery Ventilator or Heat Recovery Ventilator installed
- Minimum ERV and HRV requirements, measured at the lowest tested net supply airflow:
  - Must be at least 75% Sensible Recovery Efficiency (SRE)
  - No more than 1.1 cubic feet per minute per watt
  - Not use recirculation as a defrost strategy
- ERV must be 50% Latent Recovery/Moisture Transfer (LRMT)

R408.2.5

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## Appendix RA Board of Appeals – Residential

- Appendix RA provides guidance for establishing a board of appeals, including criteria for membership and instruction for developing rules and procedures
- Not mandatory unless adopted



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## Appendix RB: Solar-Ready Provisions

- Appendix RB does not require solar systems to be installed for a building
- It requires the space for installing such systems, providing pathways for connections and requiring adequate structural capacity of roof systems to support the systems
- Shading
  - Panel placement zones based on existing or permanently installed site elements
- Capped roof penetration sleeve
  - Provided on roofs with less than 1/12 pitch

## Appendix RC: Zero Energy Residential Building Provisions

ERI zero energy score for compliance

- The rated design must have a score less than or equal to the values in Table RC102.2 when compared to the ERI reference design for both of the following:
  1. ERI value not including on-site power production (OPP)
    - Calculated in accordance with RESNET/ICC 301
  2. ERI value including on-site power production
    - Calculated with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

**Adjusted OPP = OPP + CREF + REPC**

CREF = Community Renewable Energy Facility power production  
 REPC = Renewable Energy Purchase Contract power production.  
 Contract term duration of at least 15 years

## Maximum Energy Rating Index

TABLE RC102.2 Maximum Energy Rating Index<sup>a</sup>

CLIMATE ZONE	ENERGY RATING INDEX not including OPP	ENERGY RATING INDEX including Adjusted OPP (as proposed)
1	43	0
2	45	0
3	47	0
4	47	0
5	47	0
6	46	0
7	46	0
8	46	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table RR402.1.3 of the 2015 International Energy Conservation Code.

# Additional Resources

## Digital Codes Premium Energy Collection



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## Premium Tools and Features

<p><b>400+ Premium Codes and Standards</b> Search over 400 of the latest I-codes, standards, supplements and commentaries</p>		Only available with Premium Complete
<p><b>Offline View (Mobile App Only)</b> Download up to 15 code titles</p>	<p><b>Code Interpretations</b> Past committee interpretations on building, residential, fire mechanical, fuel gas, plumbing, energy conservation codes</p>	
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<p><b>Highlight and Annotate</b> Mark up content, highlight code book content and add annotations</p>	<p><b>Bookmarking</b> Bookmark and tag sections of interest</p>	
<p><b>Copy, Paste and Print</b> Copy, paste and print sections of codes</p>	<p><b>Errata postings</b> View the latest code corrections and changes</p>	
<p><b>Favorites Flagging</b> Flag any title by building a "Favorites List" of commonly accessed titles for quick reference</p>	<p><b>Advanced Search</b> Use multiple filters to narrow down search results and identify codes sections more accurately</p>	

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# Digital Codes Energy Continued

2021 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019

First Version: Jan 2021

**R402.1.5 Total UA alternative.**  
Where the total building thermal envelope UA, the sum of U-factor times assembly area, is less than or equal to the total UA resulting from multiplying the U-factors in Table R402.1.2 by the same assembly area as in the proposed building, the building shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements of Table R402.1.2 and the maximum fenestration U-factors of Section R402.5 shall be met.

**R402.2 Specific insulation requirements**  
In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.12.

**R402.2.1 Ceilings with attic space.**  
Where Section R402.1.3 requires R-49 insulation in the ceiling or attic, installing R-38 over 100 percent of the ceiling or attic area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.3 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves.

**R402.5 Maximum fenestration U-factor and SHGC.**  
The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 9 for vertical fenestration, and 0.75 in Climate Zones 4 through 9 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 0 through 3 shall be 0.40.

**Exception:** The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

**R402.2.3 Eave baffle.**

# Errata Central

- I-Codes since 2000
- Supporting publications

Category: 2000 International Codes	+
Category: 2003 International Codes	+
Category: 2006 International Codes	+
Category: 2009 International Codes	+
Category: 2012 International Codes	+
Category: 2015 International Codes	+
Category: 2018 International Codes	+
Category: 2021 International Codes	-
Code: International Building Code (IBC) (15)	+
Code: International Code Council Performance Code (ICCPC) (1)	+
Code: International Energy Conservation Code (IECC) (8)	-
2021 IECC – Complete List	
Published Date:	12/14/2021
File:	

<https://www.iccsafe.org/errata-central/>

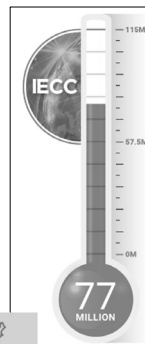
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# A Code on a Mission Campaign



- The Code on a Mission challenge aims to get over one-third of the U.S. population covered by the 2021 IECC by the end of 2023

Supporting Organizations



What's New

IECC

IECC

What's New in the IECC

Campaign Toolkit

Submit Adoption Info

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# ICC Energy and GHG Reduction Resources

- Potential topics:

- ✓ Electric Vehicle Charging
- ✓ Performance Standards for Existing Buildings
- Electrification and Decarbonization
- Zero Energy and Zero Carbon
- Embodied Carbon
- Grid Interactivity/Efficiency
- Enhancing Energy Savings through Water Efficiency and Reuse
- Integration of On-site Renewable Energy Generation and Energy Storage



<https://www.iccsafe.org/advocacy/energy-efficiency-and-carbon-reduction/>

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## Clean Energy Clearinghouse



Brought to you by the Interstate Renewable Energy Council and partners.

### CLEAN ENERGY CLEARINGHOUSE

Educational materials, quick reference guides, inspection and safety resources, and free CEU bearing training courses for building and safety professionals.

[CleanEnergyClearinghouse.org](http://CleanEnergyClearinghouse.org)

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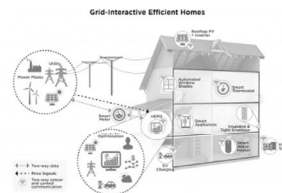
## Clean Energy Clearinghouse Continued

*Current resources include:*

- EMPOWERED Solutions: Free online webinar series on distributed energy resources for building operators, managers, and safety officials.
- Electric Vehicle Charging Safety Course
- Vehicle-to-Home Charging: Can I Power My House With My Car?
- Net Zero Buildings Week: Clean Energy Resources from Industry Leading Organizations
- Recap: The Basics of Energy Storage and Beyond
- Energy Storage Basics for AHJs and Beyond Webinar
- Solar PV Systems: Job Aids for a Consistent Plan Review Process
- Preparing to Inspect Your First PV System
- Inspecting the Building of the Future
- Distributed Energy Resource Codes and Standards
- A Checklist for Building Owners Considering Solar Energy
- Electric Vehicle Charging for Building Owners
- Efficient and Accurate Validation of PV and Energy Storage System Designs: An Introduction to SolarAPP+

*Stay tuned for resources about:*

- Energy storage safety
- Electric vehicle charging safety
- Interactive database of clean energy-related codes
- Vehicle to Grid (V2G) technology
- High efficiency building envelopes
- Smart inverters



## Conclusion



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## C405.2.4.2 Sidelit Daylight Zone

2018   
2021 

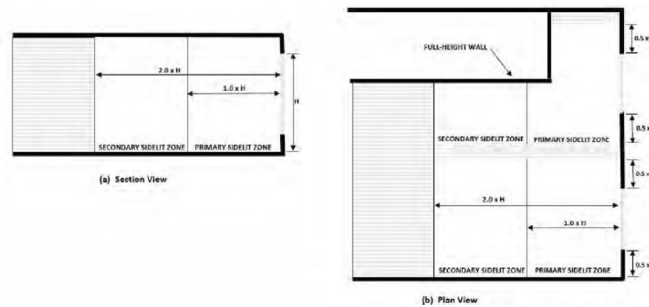

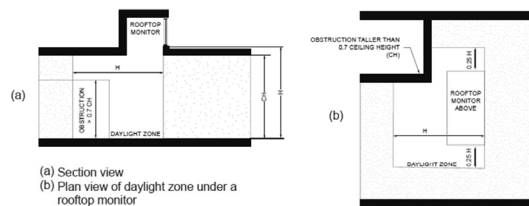


FIGURE C405.2.4.2(1)  
PRIMARY AND SECONDARY SIDELIT DAYLIGHT ZONES

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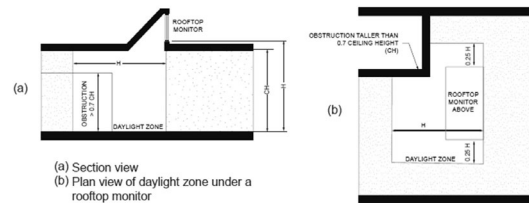
## C405.2.4.2 Sidelit Daylight Zone

2018   
2021 



(a) Section view  
(b) Plan view of daylight zone under a rooftop monitor

FIGURE C405.2.4.2(2)  
DAYLIGHT ZONE UNDER A ROOFTOP MONITOR



(a) Section view  
(b) Plan view of daylight zone under a rooftop monitor

FIGURE C405.2.4.2(3)  
DAYLIGHT ZONE UNDER A SLOPED ROOFTOP MONITOR

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# C405.2.4.3 Toplit Daylight Zone

2018   
2021 

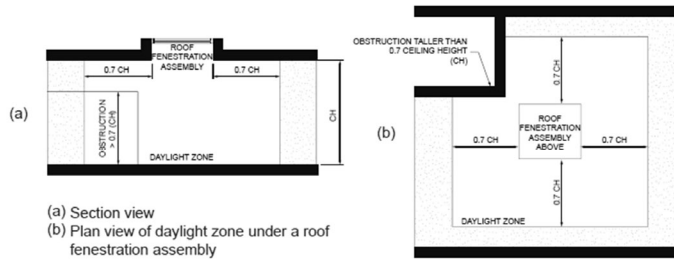
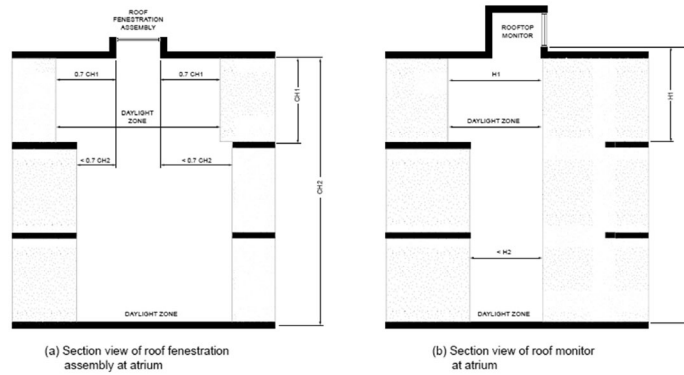


FIGURE C405.2.4.3  
TOPLIT DAYLIGHT ZONE

# C405.2.4.4 Atriums

2021 



C405.2.4.4  
DAYLIGHT ZONES AT A MULTISTORY ATRIUM